Learning from Digital Natives: Bridging Formal and Informal Learning. Final Report

Other

Learning from digital natives: bridging formal and informal learning

Research project report
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Abstract

Formal and informal learning have been viewed as competing paradigms, however, students are increasingly adopting the tools and strategies for informal learning within formalised educational settings.

This project explored the affordances of the informal practices of students in higher education by examining ways in which they used e-tools such as personal digital devices, communication tools, and social networking.

Barriers and enablers as examples of such e-tool integration within international research and practice were identified, and recommendations made on pedagogical, socio-cultural, organisational and technological aspects of the use of informal tools to support formal learning within higher education.

Executive Summary

Background – short summary

Electronic tools and mobile devices, social networking environments and virtual worlds are increasingly becoming popular. The concept of Web 2.0, coined by Tim O'Reilly in 2004 (O'Reilly, 2004), has quickly taken hold, denoting a new generation of web-based tools, environments, and services that enable new forms of collaboration and knowledge sharing between users. Many researchers and practitioners in the field have rejected the term Web 2.0 and preferred to use an alternative term – 'social software'. That is "software which supports, extends, or derives added value from, human social behaviour – message-boards, music and photo-sharing, instant messaging, mailing lists, social networking" (Coates, 2005). Whatever the term, the developments brought about by these tools and services are characterised by decentralisation of authority in knowledge creation and technology ownership; emphasis on user-generated, user-controlled and remixable content and data; and centrality of "architecture of participation" that harnesses "the wisdom of crowds" (Surowiecki, 2004).

In the UK, a recent study of students' experiences of technologies (Conole et al 2006) identified that students are using the web as "*unequivocally the first port of call*" for their studies (p.4); that the technologies are used in a "pervasive", "integrated", "personalised", "social" and "interactive" way (p.4-5); and that "students are appropriating technologies to meet their individual needs, mixing general ICT tools and resources with official course or institutional tools and resources" (p.4). This study also identified that students are developing "new forms of evaluation skills and strategies (searching, restructuring, validating) which enable them to critique and make decisions about a variety of sources and content" (p.5). "The use of these tools is changing the way they gather, use and create knowledge… shifting from lower to higher regions of Bloom's taxonomy… to make sense of their complex technologically enriched learning environment" (p.6). However, the students are also "frustrated… because of the misuse or lack of use of the tools" within their institutions of higher education (p.95). But regardless of the course structures or teacher preferences, students are using social software on their own initiative to support their studies (Kurhila, 2006).

An effect of these developments is a widening of the gap between the culture of the educational institutions and the culture of learners' lives outside school. Outside formal educational environments individuals act as active participants navigating their way independently through complex multimodal digital environments. Yet in school they are expected to submit to a pedagogic regime that is fundamentally premised on the transmission and testing of

decontextualised knowledge and skills, and which is dominated by “old-generation” technologies (Web 1.0) underpinned by a radically different philosophy and a different set of affordances.

Aims – short summary

This study aimed to explore how e-tools and the processes that underpin their use can support learning within educational institutions and help improve the quality of students’ experiences of learning in higher education.

It became clear early on that the aim of integration of informal and formal learning was not in fact desirable as the very process of integration would run the risk of formalising informal practises and may in fact destroy any benefits that informal learning offered by thus doing.

Instead what we actually wanted to understand was how tools and processes used in the informal setting could be harnessed to help support the formal activity of learning and teaching within higher education.

The study was guided by the following research questions:

1. What is the educational rationale for integrating formal and informal learning supported by e-tools?
2. What examples of such integration exist within research and practice worldwide?
3. What are students’ experiences of using e-tools to support their learning in both the formal and informal domain?
4. What are the staff’s experiences and perceptions of using e-tools to support learning within the educational domain?
5. What are the barriers and enablers to the use of these technologies within higher education?

Methods – short summary

To address these research questions, we firstly carried out a desk study identifying related international research and practice and examples of integration of e-tools and learning processes that they afford into formal educational settings. The desk study included a scoping of barriers and enablers to such integration.

Secondly, we surveyed 160 engineering and social work students across two Scottish Universities and carried out eight follow-up individual student interviews across the two subject areas. We explored with the students which technologies they are currently using for both learning and leisure activities within and outside the formal educational settings and how they would like to use such technologies to support their learning in both formal and informal domains.

Thirdly, we interviewed eight members of staff from across the institutions and subject areas to identify their perceptions of the educational value of the e-tools as well as the barriers and enablers to the integration of these tools within formal educational settings.

Synthesising the findings and outcomes of the study, the authors then developed a range of recommendations for integration of technologies within education which aim to support all those staff in higher education institutions who are shaping and implementing curriculum processes and support strategies for improving the quality and outcomes of teaching and learning in higher education.

Results – short summary

Student respondents reported making extensive use of a variety of e-tools such as mobile phones, email, MSN, digital cameras, games consoles, and social networking websites. Much of this activity was not unexpected as hardware, such as the ubiquitous mobile phone and MP3 player, have quickly risen in popularity and familiarity, as can be seen from the literature and the media, or from observing any group of today's HE student population. The same can be said for tools such as instant messenger, which again we found to be a very popular tool much used and generally preferred to the use of, for example, email.

Students reported making some use of social networking tools such as Bebo, MySpace, Wikipedia and YouTube for informal socialisation, communication, information gathering, content creation and sharing, alongside using the institutionally provided technologies and learning environments.

Most of the students we interviewed owned their own computer or had access to a sibling or parent's computer in the house. Many students owned a laptop but generally reported not wishing to bring it onto campus due to security concerns or finding it too heavy to carry about.

Ownership and use of mobile phones was ubiquitous, with many students using these for more than just voice calls, such as taking photos, sending text messages, listening to music, using it as a handy storage device instead of a USB key. Some students did report having tried to surf the internet and access their social network and information searching sites on their phone, but generally the performance was not sufficient or the cost was too high.

Whilst the students' information searching literacies seemed adequate, the ability of these students to harness the power of social networking tools and informal processes for their learning was low.

Whilst staff reported using a few Web 2.0 and social software tools they were generally less familiar with how these could be used to support learning and teaching. There were misconceptions surrounding the affordances of the tools, and fears expressed about security and invasion of personal space. At an institutional level there was reluctance to take up new technologies due to considerations of cost and the time it would take staff to develop their own skills.

Subject differences emerged in both staff and student perceptions as to which type of tools they would find most useful. Attitudes to Web 2.0 tools were different – engineers were concerned with reliability, using institutional systems and interoperability. Social workers were more flexible in tools use because they were focused on communication and professional needs.

Conclusions – short summary

What we have learnt from our 'digital natives' in this study is that new e-tools and technologies afford processes with an informal focus on self-direction, communities of practice, collaboration, sharing and even identity exploration. These young, and old, adults are active constructors of knowledge and are self-motivated. These are skills we desire in our graduates and this provides a compelling argument to bring these skills and supporting technologies together.

Students have shown that they are adaptable in their use of e-tools to support their learning and they will use the tools that that they have available if none are provided. However they do not always realise the potential of new tools and this

is an aspect in which we, as educators, can help them to develop literacies and strategies. They have also pointed the way for us to equally develop our own understandings and conceptions of processes and tools as our engagement with technologies can have an impact on their experiences.

Digital tools, personal devices, social networking software and many of the other tools explored here all help support these processes and their use is obviously motivating and has a large educational potential to support learning processes and teaching practices. Therefore we should encourage the use of these tools and processes within our institutions, amongst our staff and not least with our students to help support learning.

Recommendations – short summary

The following recommendations suggest ways in which the use of social technologies (i.e. digital tools, personal devices and social networking software) can help strengthen the links between informal and formal learning in higher education, to the benefit of both. Recommendations are organised under the four key areas – pedagogical, socio-cultural, organisational and technological.

Recommendations on pedagogical issues

1. Embrace the thinking behind the use of social technologies in formal learning contexts
2. Support the development of students' skills in social networking in relation to formal learning contexts
3. Rethink induction processes in relation to social technologies and formal learning
4. Devise new assessment practices more appropriate to 'learning as collaboration and participation'

Recommendations on socio-cultural issues

5. Build a campus culture rich in social networking opportunities

Recommendations on organisational issues

6. Build staff capacity in the use of social and associated technologies
7. Share responsibility for development across staff and students
8. Develop institutional strategies that provide reward and recognition for innovations in teaching

Recommendations on technological issues

9. Support the use of student tools within institutional settings
10. More emphasis should be placed in HE on mobile devices and universal free access to high-speed networks from anywhere within the campus.

Recommendations for further research – short summary

This study began to investigate the world of social and mobile technologies that have been taken up rapidly within societies but that are only just beginning to be explored and understood within the context of higher education. More *in-depth, longer-term studies with much larger groups of students and academics must be carried out* to explore the ways in which individuals learn using these technologies.

In this emergent area, there is a wide range of questions and topics that could form a basis for future research agenda. Although it is unfeasible to elaborate on each of the potential questions, a number of key issues arising from this study including the need to:

1. Carry out a meta-analysis of research studies into students' experience of technology.
2. Explore how technology impacts on learning outcomes.
3. Study the types of literacies that individuals develop through the use of social technologies outside formal educational settings.
4. Design longitudinal experiments to help understanding of the educational implications of emergent technologies and the literacies and learning processes they bring with them.
5. Design small-scale technology implementation experiments at a local level to measure impact on learning and further contribute to the growing body of knowledge about pedagogy and curriculum design.

1. Introduction and aims

Electronic tools and mobile devices, social networking environments and virtual worlds are increasingly becoming popular. The concept of Web 2.0, coined by Tim O'Reilly in 2004 (O'Reilly, 2004), has quickly taken hold, denoting a new generation of web-based tools, environments, and services that enable new forms of collaboration and knowledge sharing between users. Many researchers and practitioners in the field have rejected the term and the hype generated around the "venture capital-backed nuveau (sic) tech boom" (Boyd, 2006) and preferred to use an alternative term, social software, i.e. "software which supports, extends, or derives added value from, human social behaviour – message-boards, music and photo-sharing, instant messaging, mailing lists, social networking" (Coates, 2005). The terms "Web 2.0" and "social software" will be used interchangeably throughout this report. The developments brought about by these tools and services are characterised by decentralisation of authority in knowledge creation and technology ownership; emphasis on user-generated, user-controlled and remixable content and data; and centrality of "architecture of participation" that harnesses "the wisdom of crowds" (Surowiecki, 2004).

There has been a massive and rapid uptake of these technologies, especially by teenagers and young adults (Marc Prensky's "Digital Natives" (2001)). For example one third of the population of South Korea, 22 million people, are participants in CyWorld (Choi, 2006; Trondsen, 2006). Another hugely popular social networking site, MySpace has over 100 million registered accounts and is growing at a rate of 230,000 new accounts each day (http://en.wikipedia.org/wiki/MySpace) (note that the figure relates to the number of *registered accounts* rather than users). A recent survey by the US National School Boards Association exploring social and educational networking practices of teenagers identified that 96% of respondents with online access used social networking environments at least once, and 71% reported that they use these sites at least once a week (NSBA, 2007).

These technologies are not used only for socialising and connecting with others, but also for educational purposes. In the US, the NSBA study (ibid) identified that "one of the most common topics of conversation on the social networking scene is education". In this study, 59% of the students who use social networking sites have reported talking about educational topics online, with 50% stating that they specifically talk about schoolwork (ibid). In the UK, a recent study of students' experiences of technologies (Conole et al 2006) identified that students are using the web as "unequivocally the first port of call" for their studies (p.4); that the technologies are used in a "pervasive", "integrated", "personalised", "social" and "interactive" way (p.4-5); and that "students are appropriating technologies to meet their individual needs, mixing general ICT tools and resources with official course or institutional tools and resources" (p.4). This study also identified that students are developing "new forms of evaluation skills and strategies (searching, restructuring, validating) which enable them to critique and make decisions about a variety of sources and content" (p.5). "The use of these tools is changing the way they gather, use and create knowledge… shifting from lower to higher regions of Bloom's taxonomy… to make sense of their complex technologically enriched learning environment" (p.6). However, the students are also "frustrated… because of the misuse or lack of use of the tools" within their institutions of higher education (p.95). But regardless of the course structures or teacher preferences, students are using social software on their own initiative to support their studies (Kurhila, 2006).

An effect of these developments is a widening of the gap between the culture of the educational institutions and the culture of learners' lives outside school. Kukulska-Hulme & Traxler (2005) suggest that that there are mismatches in the learning processes involved in classroom settings and social situations as these processes are often based around different models of learning. Outside formal educational environments individuals act as active participants navigating their way independently through complex multimodal digital environments. Yet in school they are expected to submit to a pedagogic regime that is fundamentally premised on the transmission and testing of decontextualised knowledge and skills, and which is dominated by "old-generation" technologies (Web 1.0) underpinned by a radically different philosophy and a different set of affordances. Of course, pedagogical innovation should not be driven by technology. However, global changes in society are interconnected with technology; therefore institutions of higher education, as part of the society, cannot ignore it. Collis and Moonen (forthcoming) argue:

> The many different kinds of communication, representation and collaboration tools collectively referred to as Web 2.0 that are now being used by learners of all ages and levels outside of formal education requirements are making such fast inroads because they offer effective ways to be heard, to connect, to find and share, and to build identity. The empowerment involved needs to be considered within higher education, or else the disassociation of "school" from the "real world" will grow. (p.17).

'A key dimension of this gap is teacher's and faculty's skills in teaching using new pedagogies supported by technology. Faculty tend to teach in ways in which they were taught when they were students. Moreover, while being experts in their own discipline, they often do not have (formal) training in learning theories, pedagogy, curriculum and course design or skills in developing and implementing new learning methods, particularly those involving technology. Therefore, teachers must be supported in re-engineering their pedagogic practice as well in understanding and applying new technologies (Bianco et al 2002).

Although the mass uptake of new technologies has not been without its vehement critics heralding "death of our culture", "moral disorder" and "1984 (version 2.0)" (Keen, 2007), others have pointed to the educational potential of these technologies (Alexander, 2006; Downes, 2004; Trondsen, 2006; NMD and EDUCAUSE, 2006). To exploit this potential, some institutions and individual teachers have begun experimenting with new technologies. For example, universities have been purchasing islands in the Second Life online virtual world; lecturers have been moving course environments from institutional Virtual Learning Environments (VLEs) to MySpace and Facebook, or encouraging students to create and share content resources using blogs, wikis and podcasts. A range of educational projects across the globe have been concentrating on providing students with hardware such as laptops, mobile phones or handheld devices to support their learning activities. Anyone familiar with the current literature, the media, and academic conference themes will agree that educators are actively debating the potential and the ways of using these technologies in education. A key question is: *What is the actual value of these technologies and the processes they afford for formal learning and should institutions be investing in them?*

This report describes findings of a project "Learning from Digital Natives: Integrating Formal and Informal Learning" (LDN, www.academy.gcal.ac.uk/ldn) aimed at exploring how these technologies and the processes that underpin their use can support learning within educational institutions. The project was funded by the UK Higher Education Academy (www.heacademy.ac.uk) in 2006-2007 within a research programme aimed at improving the quality of students' experiences of learning in higher education

(www.heacademy.ac.uk/ourwork/research). The study was guided by the following research questions:

1. What is the educational rationale for integrating formal and informal learning supported by e-tools?
2. What examples of such integration exist within research and practice worldwide?
3. What are students' experiences of using e-tools to support their learning in both the formal and informal domain?
4. What are the staff's experiences and perceptions of using e-tools to support learning within the educational domain?
5. What are the barriers and enablers to the use of these technologies within higher education?

To address these research questions, firstly we carried out a desk study identifying related international research and practice and examples of integration of e-tools and learning processes that they afford into formal educational settings. The desk study included a scoping of barriers and enablers to such integration. The findings of the desk study are presented in Section 2 and partly Section 5 of this report.

Secondly, the research study explored what technologies students are currently using for both learning and leisure activities within and outside the formal educational settings and how they would like to use such technologies to support their learning in both formal and informal domains. The findings are outlined in Section 4.1.

Thirdly, the project investigated the academic and support staff's perceptions of the educational value of the e-tools as well as the barriers and enablers to the integration of these tools within formal educational settings. The results are discussed in Section 4.2. The findings from student and staff interviews are discussed in Section 5, and compared to the desk study findings. An outline of the methodological approach to the data collection is provided in Section 3.

Finally, synthesising the findings and outcomes of the study, the authors outline a range of recommendations for integration of technologies within education (Section 6). The recommendations aim to support all those staff in higher education institutions who are shaping and implementing curriculum processes and support strategies to improve the quality and outcomes of teaching and learning.

2. Background

2.1. Setting the scene: Digital natives vs digital immigrants

The digital native/digital immigrant distinction was coined by Marc Prenksy in 2001 (Prensky, 2001). It differentiates between those who were brought up in the digital age, the 'natives' (also known as the 'Millenials' or the 'NetGen') and those who were not, the 'immigrants'. Prensky's "native speakers of the digital language of computers, video games and the Internet" (p.1) are assumed to be any person born between 1982 and 2000. If we accept this definition, then many of these 'digital natives' are currently entering various levels of education.

While this distinction and the evidence to it is arguable, Prensky's work draws our attention to the fact that many young people today are experienced with technology. They are using a variety of devices to access software and services to

support social networking and for a range of informal and independent learning activities. These technologies include hardware such as personal computers, mobile phones, digital cameras, personal digital assistants (PDAs), game consoles, portable media players, and iPods. The hardware is being used to access a range of software that supports communication, the creation, sharing and exchange of information and resources through text messaging, email, blogs, wikis, instant messaging and social networking websites. The latter include services such as MySpace, Bebo, FaceBook, Flickr.

Social interaction and collaborative learning in educational settings through the use of computer-mediated communications (CMC) systems – email, online discussion groups and synchronous chat facilities – has been well documented. These tools are normally supplied by the institution, for example, through a Virtual Learning Environment (VLE), such as Blackboard.

Students are also using their own devices to manage and support learning, using popular communication tools such as Short Messaging Service (SMS), Microsoft MSN Messenger, Skype and social networking sites such as MySpace, Bebo or Facebook. These tools serve a dual function. They enable students to collaborate, communicate and share resources and course-related information. They also support students in daily social and leisure pursuits such as socialising and pursuing hobbies.

Sefton-Green (2004) maintains that the use of digital technologies allied to peer-group cultures are enabling young people to develop a wide range of skills, such as engaging with discourses and constructing meaning, exploring identity and asserting control. Sefton-Green maintains that young people today are used to negotiating identities and roles for themselves in online communities of practice and social networks. For example, he states that young people are taking on roles of teacher and learner in peer-based online groups.

Similarly, some researchers have argued that the use of massively multi-player online games supports sophisticated educational processes. Such multi-player games result in activities akin to scaffolding where learners are supported by peers. For example, Willett & Sefton-Green (2003) discuss scaffolded learning within ‘Habbohotel’, a popular chat-room for teens, in terms of the structured features of the website and how users progressively learn to interact in more complex ways. They discuss aspects of informal learning through chat-room interaction in terms of ‘play’ with language, identities, sexuality, risk-taking and taboo subjects.

Much of the current research is focused on information systems and sociological aspects of these technologies. There is less research exploring the educational aspects of students' use of technology for learning outside formal instructional settings. It is useful to explore learning processes taking place when individuals use technology outside formal educational settings. Firstly, however, we must explore the distinction between formal and informal learning, which, in the context of emergent social technologies, is becoming increasingly blurred and problematic.

2.2. The formal and informal learning distinction

Historically, formal and informal learning have been viewed as competing paradigms, and conflicting claims as to the superiority of one or another have been made (Colley et al 2002). To exacerbate the matters, no universally agreed definition of either exists. For example, Eraut (2000) and Sternberg et al (2000)

suggest that a great deal of learning is non-formal, in that it results during the course of daily life events and activities related to work, family and leisure. Billett (2001), claims that the concept of informal learning itself is redundant because all learning occurs within social organisations or communities that have formalised structures. Eraut (2000) suggested that a more useful term may be 'non-formal learning'; however this could be argued to be just as vague and widely defined as the concept of 'informal learning'. Both Eraut (2000) and Billett (2001) agree that most learning takes place outside formal educational settings as any human activity will result in learning.

It is increasingly being recognised that the boundaries and relationships between the concepts of formal and informal learning are not quite as distinct and polarised as is often implied. For example, can talking about an assignment informally, in an informal virtual space such as MSN Messenger, yet physically being located within a formal university library, be classed as either formal or informal learning? Or could a conversation about a course topic or assignment during a lecture or in a library be described as either formal or informal? A key question is: *Is it possible to differentiate formal and informal learning processes? And if so, can the benefits of informal learning be exploited in formal learning situations?*

Benefits and processes of informal learning have been extensively explored (e.g. Beckett & Hager, 2002; Eraut, 2005; Hodkinson & Hodkinson, 2001; Sefton-Green, 2004). In addition, a range of dimensions of formal and informal learning have been outlined, including dichotomies such as course-based versus non-course based activities (McGivney, 1999), implicit versus explicit learning (Reber, 1993), non-intentional versus intentional learning (Eraut, 2000; Hodkinson & Hodkinson, 2001), informal versus formal spaces, physical or virtual (Digenti, 2003) or unstructured versus structured learning (Sleezer, 1996).

However, if we want to compare formal and informal learning we must provide a working definition of these concepts. For the purposes of this report, we build on the features outlined by Eraut (2000) and The European Commission (2001) to define these two forms of learning as follows:

> **Formal learning:** Learning provided by an education or training institution, structured (in terms of learning objectives, learning time or learning support), involving the presence of a designated teacher or trainer, and leading to certification or an award of qualification or credit. Formal learning is intentional from the learner's perspective.
>
> **Informal learning:** Learning which is not provided by a formal educational or training institution and typically does not lead to certification. Informal learning results from daily, social life activities related to education, work, socialising with others or pursuit of leisure activities and hobbies. Informal learning may be structured or non-structured in terms of learning objectives, learning time or learning support. Informal learning may be intentional or non-intentional (incidental) from the learner's perspective.

Both formal and informal learning have strengths, weaknesses, and educational benefits. When informal learning is formalised, its benefits may no longer hold in formal environments. Instead we want to understand what educationally beneficial learning processes are taking place when individuals are learning informally, using e-tools (in particular social software), and how formal learning can be improved by building upon those informal processes and by integrating the e-tools to support learning within higher education.

2.3. Processes facilitated by social software

McGee and Diaz (2007) remind us that "regardless of pedagogy and technology, instructors and learners are doing the same things they have always done throughout the [learning] process. For example, instructors must communicate, assess, provide feedback, observe, present information and organise activities. Learners read, present a point of view, search/collect/analyse information, practice, create and respond" (p.38). Therefore in analysing the educational value of technologies, it is more useful to consider them within the context of these teaching and learning processes and activities rather than as discrete tools.

The following question thus is essential: *What educational processes are fostered by social and personal technologies?*

A range of studies have been exploring issues surrounding the use of social software and participation in social networking environments (for a bibliography see www.danah.org/SNSResearch.html). For example, early research findings point to:

- strong association between use of sites such as Facebook and the students' development and enhancement of their social capital as well as their psychological well-being (Ellison et al 2007)
- social networking sites fostering increased civic participation (Min, 2007; Khokha, 2006)
- affordances of social networking environments for knowledge construction processes (Paulus, 2007)
- emergence of new types of literacy practices of "participation" and "remix", whereby the former questions the dichotomy of consumption and production and the latter challenges the notion of "copying and pasting" inherent to this dichotomy (Perkel, forthcoming)
- games and simulations fostering development of metacognitive skills, such as problem solving, interpretive analysis and strategic thinking; increased motivation (Cope and Kalatzis, 2000)
- affordances of these technologies in terms of transfer of knowledge between various contexts, such as between online and offline realities and between local and global networks (Mejias, 2005).

Although many of these studies focus on information systems and sociological aspects of emergent social technologies rather than their educational potential, the findings point to their potential in terms of some important competencies and literacies that are essential for effective functioning within the modern society. A report recently commissioned by the UK Department for Information and Skills (Leitch, 2006), outlining the national requirements for development of competencies in the workforce suggests that the UK is failing to equip learners with skills necessary to retain the country's competitiveness in the global economy. The missing skills range from basic ones of functional literacy and numeracy to digital literacies and 'innovation skills' such as creativity, problem-solving, collaboration and resourcefulness.

Effective construction and sharing of knowledge is an integral component of these literacies. Individuals' ability to find, evaluate, process, create and share information and synthesise knowledge from this information in order to solve complex and novel problems is of paramount importance for successful participation in the knowledge economy in the new, networked, world. Along with basic types of literacies and competencies, such as information literacy and technology literacy, critical thinking skills, and production and consumption of knowledge (Livingstone, 2002; 2004), use of social software and virtual worlds

necessitates and fosters new types of literacies, such as visual literacy (Bamford, 2003) and competencies in reuse of digital artefacts and products (Perkel, forthcoming). Many of these new literacy practices critically challenge the norms of knowledge production and consumption in the institutions of higher education. Teachers and students alike must acquire these literacies.

Although, as we have seen, there is evidence that students acquire some of these literacies when using digital tools for social purposes and transfer skills learned in social contexts to their learning in educational contexts (Conole et al 2006), other studies suggest that learners have difficulties in transferring these literacies across boundaries (Carmichael et al, forthcoming). While transfer of knowledge and skills within formal and informal learning has been well-researched (Tuomi-Groehn and Engeström, 2003), factors inhibiting the transfer of literacies from social digital environments to formal educational contexts are not well-understood. One important factor inhibiting transfer could be learners' expectations on how they will learn at university (Conole et al, 2006; Creanor et al, 2006).

Understanding key learning processes underpinned by social software is important. However, there is little educational literature in this area, since most studies focus on sociological and information sciences perspective on social use of social software. There is evidence in the literature that students have difficulty in identifying such processes and organising their learning around these, preferring to concentrate on e-tools. Therefore in this study we use e-tools and collections of such tools within virtual environments as a reference point in our interviews with students and teachers. What are the key commonly used e-tools and what could their potential to support learning be? We discuss this question in the next section.

2.4. e-Tools to support learning

In this section we consider e-tools within two broad categories of hardware (section 2.4.1.) and software (section 2.4.2.). We also briefly discuss networked access and connectivity as vital components of the use of e-tools (section 2.4.3.).

2.4.1. Hardware

Kukulska-Hulme and Traxler (2005) suggest that learning outside the classroom can be supported by hardware such as mobile phones, handheld computers (such as PDAs), laptops, tablet PCs and personal media players. These devices can be used for communication and collaborative learning activities. They offer a range of functionalities such as web, email, games, e-books, MP3, video, SMS and MMS. Sefton-Green (2004) discusses use of hardware that students may own. The Horizon Report (NMD and EDUCAUSE, 2006) discusses how a range of personal technologies, due partly to their now ubiquitous nature, are increasingly being viewed as the service delivery platform of choice. The potential for educational use of some of these devices is briefly discussed next.

2.4.1.1. Mobile phones

Many current models of mobile phones have the capacity for network access, communication tools, and software to support Internet-based activities and personal broadcasting. Mobile phones have been used for language learning (Levy and Kennedy, 2005); testing knowledge of driving theory (Stead and Colley, 2005); improving literacy and numeracy skills (Stead and Colley, 2005); and

delivery of learning content and discussion activities from a VLE via use of a web enabled smartphone (Trinder et al, 2005; Wishart et al, 2005).

2.4.1.2. Personal media players

Personal media players support a range of audio and video formats. Most media players are equipped with flash memory or miniature hard disk drives, and have PC connectivity, usually via a USB port or Bluetooth to allow downloading of music and other file formats. There has been a marked increase in ownership of such devices (Macworld, 2006). The market for MP3 music players was revolutionised when Apple introduced the iPod in 2001. The iPod is currently the most widely owned portable media player (Macworld, 2006). The term 'podcast' originates from the name of this device. The name iPod is often used generically to describe the hardware, though many other makes and styles exist.

2.4.1.3. Computers, PDAs, laptops and tablet PCs

Offering network access, communication tools, and software to support Internet-based activities and personal broadcasting, these devices differ slightly in their appearance, size and personalisation. PDAs are the smallest, more mobile devices, and desk based computers are the most powerful, tethered devices (Trinder, 2005). PCs, tablets and laptops offer most by way of processing power, internet access and software choice, but increasingly PDAs come with built-in GPRS, Bluetooth, or Wi-Fi offering reasonable connectivity and Web 2.0 functionality even on these small devices. Context-aware devices such as GPS-enabled PDAs can be used to gather data, photos, and information (Price and Rogers, 2004; Sutch and Sprake, 2005; Lonsdale and Beale, 2005).

2.4.1.4. Game consoles

Consoles can be portable such as the X-box and connected to a TV or other screen; or personal and pocket sized, such as the Sony PlayStation Portable (PSP). The Sony PSP is an example of a mass consumer mobile device, which could have far more potential for mobile learning than its Nintendo competitors such as the DS due to its Internet capabilities (Dipert, 2006). This device has complete multimedia functionality, high speed interfaces including USB 2 and PC connection and an e-book reader. Users can surf the Web with the new 2.0 system software upgrade and it has an HTML compatible browser with Wi-Fi built in. It is also relatively cheap compared to other devices with similar capabilities. Games consoles offer a variety of options for formal learning (Skills Arena, cited in Naismith et al, 2004), or for informal ‘play’ (Sefton-Green, 2004).

2.4.1.5. Other hardware

Traditional classroom-based hardware tools, such as interactive whiteboards or voting systems may not seem important in this discussion as these are generally specialised, high priced and not likely to be available to students outside the educational institutions. However, some institutions allow students to use these technologies outside class timetables and this has proved popular and supports less formal, collaborative, learning (Bates 2000; Creanor,Trinder Gowan & Howells 2008).

2.4.2. Software

Software includes ‘old’ technologies – such as desktop publishing, modelling and simulation software, virtual learning environments like Blackboard – as well as

emergent Web 2.0, social networking software and services, for example web-based document processing like Google Documents, or social book marking such as del.icio.us.

2.4.2.1. Web 2.0 or social software

We have already discussed some of the key metaphors and functionalities underlying Web 2.0 or social software. Mejias (2005) provides a typology of Web 2.0 applications associated with social software, which is outlined and extended in Table 1 below with popular examples. Some of these applications may have particular educational significance, such as virtual worlds, blogs, wikis and social bookmarking, and will be discussed further in the following sections.

Table 1 – Typology of Web 2.0 Technology (adapted from Mejias, 2005, p.3)

Software Application Type	**Examples**
Multiplayer gaming environments (Multi-User Dungeons, Massively Multiplayer Online Games, 3D Virtual Worlds)	EverQuest World of Warcraft Second Life
Discourse facilitation systems (Synchronous – instant messaging, chat; Asynchronous – e-mail, bulletin boards, discussion boards, moderated commenting systems)	MSN Messenger Google Groups MySpace Groups
Content management systems (blogs, wikis, blikis, document management, web annotation utilities)	Blogger Wikipedia Plone
Product development systems (especially for Open Source software)	Sourceforge
Peer-to-peer file sharing systems	Napster BitTorrent Gnutella
Online bidding systems	eBay
Learning management systems	BlackBoard Moodle
Relationship management systems	MySpace Friendster Bebo
Syndication systems (list-servs, RSS aggregators)	Newsfeeds
Distributed classification systems (social bookmarking, tagging)	Del.icio.us Blinklist Connotea Flickr

2.4.2.2. Multiplayer Gaming Environments

Using networking and Internet technologies, many people can enter these virtual worlds and play the game and interact with other players at the same time. Each person is physically represented in these worlds by an avatar, which can be customised as desired. Antonacci and Modaress (2005) highlight the educational opportunities of Second Life, a virtual world which is created and inhabited by its users, through their description of a range of possible applications from a clear constructivist perspective. They propose a framework which can be used to design pedagogical activities to maximise the potential of virtual worlds involving three categories of activities: person-person, person-object and object-object interactions. Person-object activities could include students designing and building objects, relevant to the fields of engineering, architecture and fashion. Object-object activities could be useful in science and geography courses for

students to explore how hazardous chemicals enter the water supply or how mountains are formed when two tectonic plates collide. Person-person interactions have potential to support collaborative work in distributed teams or role-playing activities, for example in healthcare professions. Students can explore patient interactions from different perspectives – this is often difficult or impossible to do in real life. Students can then engage in reflective learning concerning their experiences and their application to future patient encounters in the real world.

However, Antonacci and Modaress point out a number of barriers to the use of Second Life in education, including the high-end hardware and connectivity requirements for an appropriate graphics card. Skills which are required for more advanced activity such as scripting and building can take time to develop. Finally there are ethical issues in relation to deception of other participants and obtaining consent from users before using information from their experience.

2.4.2.3. Blogs

Blogging can be broadly defined as "the reverse-chronological posting of individually authored entries which include the capacity to provide hypertext links and often allow comment-based responses from readers" (Bruns and Jacobs, 2006, pp.2-3). Blogs can be used as learning tools in a variety of ways. The way in which a blog is implemented, however, determines its value in terms of its operational structures and response mechanisms, as well as discourse style and method of recording ideas, commentary and institutionally relevant information, as noted by Bruns and Jacobs.

Blogging has been used in both schools and HE institutions, for example to involve previously inaccessible experts to support learners (Richardson, 2006). A blog around a work of literature that the students were studying included contributions from the author. Richardson argues that this increased learners' motivation and helped them to get their work out of the school context and into the wider world. The potential of blogs to support regular writing practice and reflective learning has also been noted (Fountain, 2005).

2.4.2.4.Wikis

Wikis are collections of web pages which function as online encyclopaedias or shared information repositories, which users can edit themselves by adding, removing and changing content. The most well-known wiki by far is Wikipedia, a free-content encyclopaedia which anyone can edit. This gives the users control over the process of knowledge construction, which involves challenging the social norms and practices inherent in an educational course (Lamb, 2002). People can not only write, edit and publish their own work, but can also rewrite, edit and 'unpublish' the work of others. Berry (2006) describes the use of an open wiki called 'Wikiville' with secondary school children for pupils to add and edit entries for their hometowns. Berry cites mutual trust as a social benefit as classmates had to learn to trust and respect each other's work. Richardson (2006) argues that by not tracking who has changed what through use of a single password, responsibility, policing of content and ethics are promoted as everyone has a stake in the results.

2.4.2.5. Social bookmarking

Social bookmarking websites such as del.icio.us and Blinklist involve the concept of (collaborative) tagging, often referred to as a folksonomy, as people build and categorise resources using keywords defined by other users. The resulting ranked

lists of resources are made accessible to the public or on a specific network so that other people with similar interests can search and view the links by categories and tags. Grant (2006) argues that search results can be more informative and relevant than search engines or authoritative sources as you can find resources that other people found useful and see how these resources were categorised.

2.4.3. Networked access and connectivity

Network access is a vital component to the use of any of these hardware and software tools. The ability to connect (via a cable, wireless, or GPRS) to the network and have the correct software to use could potentially present the biggest barrier of all. If network access is not readily available to the students, use of these tools will be restricted. Students on campus will have potential to access networks as long as a suitable hardware device with connectivity is available to them. Competition for computers in labs can affect this, as can lack of a secure wireless network for students to use with their personal devices. Students will have to be able to access networks at home, at work, halls of residence, or in libraries, internet cafes, and other public spaces, as well as on the move via enabled mobile phones if they own suitable models.

Quality of access also becomes an issue. Not all students will have broadband connection at home which is essential to use of some of the discussed tools (such as multiplayer gaming environments). A short video clip available on campus via the university network may not be useable at home or on a mobile phone due to file size, download speed, or even installation of appropriate software such as video codecs (software plug-in or hardware required for the correct compression and decompression of digital video). Where students have access, and of what type, should be given consideration when planning the use of e-tools to support learning.

Ownership and control are important dimensions of the e-tools. e-Tool ownership may be viewed on a spectrum ranging from public to private – hardware tools may be owned by the institution, the student, or may be publicly available. Similarly, learning environments, both virtual and physical, range from public to private. The relationship between these seemingly dichotomous variables is complex and interlinked: students may use their own e-tools in a public or institutionally controlled environment.

Let us consider some examples (from literature) of uses of public, institutional or student-owned e-tools across a range of environments within formal and informal learning domains.

2.5. Use of e-tools to support learning: Examples from literature

The examples involve both cases of spontaneous use by students as well as organised use initiated by teachers. The analysis of each example is focused on the following aspects:

- *description* of the example (Summary)
- *rationale* for use of e-tool, as described by the author(s) (Rationale)
- *educational processes* that the e-tools support (Processes)
- *evaluation results* wherever reported (Outcomes)
- *implications for use within education* (Implications).

2.5.1 Example 1. Mudlarking in Deptford

(Sutch and Sprake, 2005)

Summary: Groups of schoolchildren where provided with hand-held mobile devices which they could use to write in, record audio, take pictures, access reference resources online and, with satellite navigation, pinpoint their exact location. The students made a multimedia map of their walks around Deptford, carrying out experiments and recording findings – capturing all that they found significant about the environment. These records could then be accessed by later groups and extended or edited into an evolving and increasingly rich and diverse resource.

Rationale: The full potential of field trip activities is often not realised since it may be a static, one-way experience. The overall purpose was to rethink the traditional guided tour and to enable learners to actively engage with a physical environment, using mobile technology, to design and produce their own guided tour.

Processes: In this example, hand-held mobile devices were used to support communication and collaboration between students working in pairs or small groups, using and building upon the observations of previous groups. Mobile devices were primarily used to source, create, and share resources. For example students added 'virtual notes' about the environment for other learners to use. This 'evolving tour' consisted of student-generated data in the form of recorded audio, MP3 files, photography, drawings and text added into the virtual landscape.

Outcomes: Authors report that the ability to record their own experiences for an audience motivated the students. They argue that the variety of methods available to record stories meant that all students were able to capture experiences and share these with others. Problems largely centred on technology issues.

Implications: Integrating physical and cognitive activities has the potential to enhance learning. Mobile communication technologies can add another dimension to learning. Mobile and satellite networks allow students to record their observations in real-time, and immediately view connections through layers of historical evidence. In this example, the authors argue that learners' motivation is increased, but the example does not provide any evidence that learning was improved. More studies are needed to demonstrate this kind of learning impact. Teachers who use technologies in their teaching should be encouraged to evaluate the impact on learning outcomes and publish the results. Such studies will support accumulation of a body of evidence on the educational impact of e-tools.

2.5.2 Example 2. Using context awareness to enhance visitor engagement in a gallery space

(Proctor and Burton, 2003 reported in Lonsdale and Beale, 2005)

Summary: Museums, galleries, and heritage sites seek to engage visitors in the artefacts they exhibit and encourage participation in the learning space provided. In Tate Modern's multimedia pilot study, location-aware applications delivered

content that is appropriate to the visitor's location within the gallery space. Visitors used portable, screen based devices to see video and still images providing additional context for the works on display. They could listen to experts talk about details of a work, while the details were highlighted on the screen. Visitors could use interactive screens to answer questions about artefacts or to create their own soundtrack for a work by layering sound clips. Visitors could have additional information e-mailed to them. Messages could be broadcast to users during the tour.

Rationale: Context-awareness may enhance the usability of mobile devices by making it possible for users to continue with other activities without having to pay too much attention to the device. Individuals can receive information about artefacts in different formats. Such portable context-aware devices connected to a central server provide augmented experiences that go beyond basic location awareness.

Processes: In this example, the portable networked location-aware devices were primarily used to source and distribute information related to the gallery artefacts being viewed.

Outcomes: The authors do not report evaluation results.

Implications: Mobile learning is conceived of as the mobile equivalent of e-learning. The assumption is that content can be delivered through mobile devices. However, mobile devices such as phones and PDAs are used in a huge variety of settings and environments, and we cannot rely on having the user's full attention. Mobile learning is not something that can be delivered; it is something that happens within a context. This example attempts to contextualise learning. The example, however, focuses on 'content push' rather than on engaging in activities. Limited activities were provided through question and answer sessions. More engaging, group or multiplayer activities could be implemented.

2.5.3 Example 3. Second Life: Role play

(Antonacci and Modaress, 2005)

Summary: Doctors, nurses, and other medical professionals interact with patients through patient-encounter role playing strategies within a virtual medical clinic set up in Second Life. Each student takes the part of the doctor, nurse, patient, or patient spouse. After the role play, students discuss and reflect on their experience and its application to future patient encounters.

Rationale: Simulating doctor-patient interactions in a virtual environment can provide a safe location for learners to practice their skills. Through changing roles students can see patient encounters from different perspectives.

Processes: Second Life is used primarily to support development of communication skills.

Outcomes: The authors do not report evaluation results.

Implications: Use of simulations to support learners in developing interaction and communication skills is not new: since the emergence of multimedia a range of software products for similar role play activities (for example, in the context of training call centre or sales staff) have been around. However, development of those multimedia products required specialist skills and tools for design, therefore

the simulations were costly and unaffordable for use within an educational context. In contrast, conducting role plays and developing simulations in Second Life is much easier, although granted it still requires scripting skills. Second Life and similar virtual worlds can be suitable environments for developing and conducting learning activities that for some reason are not possible to carry out in real-life settings. However, while role play can enhance learning, it may be possible to conduct it in a physical environment. Second Life can be useful if learners are distributed. In this particular example, the learner group appears to be based in the same location, therefore the benefits of using Second Life are unclear.

2.5.4 Example 4. Second Life: Tectonic flow

(Antonacci and Modaress, 2005)

Summary: In this example, geology students use Second Life to discover how objects interact, for instance how mountains are formed when tectonic plates collide. By creating objects and scripting them to interact with each other, tutors simulate tectonic flow. Students manipulate the flow by changing variables and observing the results. This allows them to better understand the relationships among tectonic plates.

Rationale: To allow learners to explore physical and procedural processes impossible to observe in a real-life context.

Processes: Learners engage in a simulated experimental activity. The paper does not provide enough detail as to whether students engage in other types of activities in the process – for example, communicating and collaborating with other learners.

Outcomes: The paper does not report evaluation outcomes.

Implications: Second Life can allow learners to experiment with physical and procedural processes in simulated setting and observe outcomes, in order to better understand relationships among variables and objects. The learning experience could be improved if students created the simulation in Second Life themselves.

2.5.5 Example 5. Language learning via mobile SMS

(Levy and Kennedy, 2005)

What: This initiative tested the use of a text messaging service to support third-year students of Italian Language and Literature at Griffith University in Australia to learn new vocabulary. Students were sent new words, definitions and example context sentences at appropriately spaced intervals in between the scheduled lessons and tutorials of their course.

Rationale: To experiment with mobile texting for language learning, since, as the authors argue, there is evidence in the literature suggesting that SMS technology might prove especially effective for vocabulary learning.

Processes: Texting was used to support communication between the teacher and the students. The communication, however, was mostly structured around the ‘content push’ metaphor, rather than a two-way communication. There is no

indication in the paper that the system was used to support communication and/or collaboration between the students. Mobile messaging was used primarily for content delivery. The vocabulary was embedded in questions that were sent by the teacher to the students. Teachers texted feedback on the responses to the students.

Outcomes: Students were contacted for evaluation in four ways: via telephone (formative evaluation, during the course), a poll in the class (formative evaluation, during the course), a questionnaire survey (summative, at the end of the course) and a focus group (summative, two weeks after the completion of the course). Measures focused mainly on exploring students' satisfaction with this method of vocabulary learning (95% were satisfied in general) as well as obtaining their views on issues related to the organisation of the course (format of the text messages, frequency of texting, topics for messages, etc). Unfortunately, more in-depth questions related to the educational effectiveness of the approach, the impact of text messaging on learning and the potential barriers were not explored in this example.

Implications: Mobile texting can be used to deliver small chunks of content (in this case foreign words and questions about their use). This is a typical example of pushing 'new' technology into an old pedagogical metaphor. Since the evaluation focused primarily on student satisfaction measures, the educational effectiveness of this approach remains unclear.

2.5.6 Example 6. An essay evolves: Use of blog and wiki to track students' progress in essay writing

(Reynolds, 2007)

Summary: An undergraduate psychology student uses a wiki to write an essay for her cognitive psychology class (note that the actual author of this experimental activity is a writing mentor at London Metropolitan University in the UK). In addition, the student uses a blog linked to her wiki to share her thoughts on researching and writing her essay. She documents and reflects on each stage of essay writing – from defining research questions and collecting references to reflecting upon the assessment and feedback from an expert. Peers and experts worldwide are invited to comment on her reflections in her blog and contribute to drafts of her essay through the wiki.

Rationale: The student in Reynolds' example explains her aim:

> The prospect of tackling an academic assignment is often daunting and anxiety-provoking, even for students who already know a lot about the topic in question. Being given model essays and model answers can actually make the problem worse; it often seems as though the writers managed to produce perfectly coherent, fully-formed arguments from thin air. Even if we do get going, how do we know if we're on the right track with the content of our assignment? This experiment aims to shine a light into all of these dark corners… The really excellent thing about this project is the fact that it is happening as a Wiki, which means that you will be able to help me as I write.

Processes: Writer uses wiki to construct and refine an essay in collaboration with peers and experts. In addition, the writing process is supported by a blog, through which the student discusses issues and ideas and communicates with peers and experts worldwide. This is a good example of collaborative knowledge construction. The student uses a wiki to store, share and track various versions of her essay; she uses a blog to document the writing process. The student engages

her peers in commenting on her thoughts and reflections via the blog. Her peers give formative feedback on the version of the essay. Experts provide in-depth feedback on her writing process. She reflects on the feedback and discusses her thoughts with her peers.

Outcomes: Although no formal evaluation results are available, a review of entries in the blog demonstrates sustained reflective communication and interaction with peers.

Implications: Nexus of informal and formal learning is clearer in this example than it is in the previous examples. This example demonstrates how e-tools can support collaborative and reflective processes behind academic writing. The development of tacit knowledge on how to write well within a discipline is made explicit through discussion with peers and experts.

Conclusions from the case studies

Many case studies reported in the literature are from the formal rather than informal domain. These cases of use of e-tools in formal and informal learning contexts, although limited, illustrate the characteristic lack of examples of truly pedagogically innovative uses of e-tools, at least as far as publications are concerned. Most of these examples are from the formal learning domain, and they illustrate predominantly teacher-organised and teacher-initiated use, focusing on institutionally-owned, student-owned or publicly available tools and environments. Some *potentially* educationally beneficial processes and literacies are theorised (communication, sense making, collaborative construction of knowledge, and reflection), however in most cases it is still unclear what the actual educational benefits are. In a limited number of published examples where evaluation data is reported, it is mostly focused on student satisfaction measures rather than seeking data on how the use of these technologies impact learning outcomes and how barriers can be identified, analysed and addressed.

This lack of comprehensive data is understandable in this emergent domain. However we urgently need to start progressing beyond theorising the potential towards more in-depth empirical studies of how students actually use and adapt social technologies (both those that they own, and those that are provided by educational institutions) for *learning purposes.* This study (2006-2007) is an attempt to begin to collect such data on students' and teachers' actual experiences of using e-tools to support learning in both formal and informal domains. It is by no means comprehensive, due to its limited duration and scope, however it provides empirical data, a synthesis of previous literature and some recommendations for practice.

The methodology of the study is described next.

3. Methods

In this section, data collection and analysis procedures, data collection instruments and the respondents are described.

3.1. Data collection methodology

The study was carried out within two different subject disciplines in two contrasting universities (pre- and post-1992). The subject disciplines included

social work and engineering, and the institutions were University of Strathclyde and Glasgow Caledonian University.

The two institutions were chosen in an attempt to identify potential differences of approach and attitudes to the use of e-tools, however there was not enough of a difference found to be statistically relevant so we did not pursue this in our data analysis.

The choice of different subject areas was to potentially allow us to explore differences between attitudes and pedagogical approaches between two different areas. Known age differences (i.e. young students for engineering and more mature students for social work) across the subjects areas were also expected and this was expected to provide contrasting data.

To gain access to the students and staff, key individuals within the relevant Schools in both Universities (such as Deans/Associate Deans or experienced lecturers) were contacted by e-mail and asked to provide assistance in identifying and contacting potential classes of students and staff who would be willing to participate in the study. A sample invitation letter is attached in Appendix 1.

Initially, the data collection methodology was planned to include the following components:

1) Focus groups involving third-year students in these disciplines at each of these two Universities. The focus group participants were to be identified from the survey results. Four focus groups of around six to eight students were planned:

- 1 x LowTechCourse/HighTechStudent
- 1 x HighTechCourse/LowTechStudent
- 1 x LowTechCourse/LowTechStudent
- 1 x HighTechCourse/HighTechStudent

Each group would consist of both social work and engineering students from both institutions.

Criteria for this identification, e.g. how to define a high technology course and a high technology student, was expected to emerge from the survey data, as well as asking would the definition of a high tech engineering course/student be the same as a high tech social work course/student?

Through the focus groups we hoped to be able to identify six participants who would be willing to participate in a further one-to-one interview to examine what it means to be a digital native from their perspective and understand their expertise and experiences, allowing us to draw out the barriers and enablers from both the focus group and interview data.

2) Student interviews were planned to be six one-to-one semi-structured interviews with high technology students, ideally who had a learning artefact available that could be used during an IPA/InterviewPlus (Mayes, 2006) approach

- 3 x HighTechCourse/LowTechStudents
- 3 x HighTechCourse/HighTechStudents

3) Staff interviews, particularly teachers, managers and support staff in disciplines of social work and engineering at the Universities of Strathclyde and Glasgow Caledonian. Interviews were intended to be a mixture of face-to-face and telephone/videoconferencing as appropriate.

Due to issues arising from the timing of the data collection component of the project in the academic year – such as collision with exam timetables for students and the inter-semester break – there was little uptake in student volunteers for either focus groups or interviews. The lack of students volunteering to be interviewed meant that we could not sample as we had wished to include these categories of low technology use and high technology use.

In view of this the data collection methodology was revised to include instead a questionnaire survey, followed by interviews with eight students and eight members of staff across both institutions.

3.1.1. Student questionnaire survey

The aim of the questionnaire was to examine the extent of e-tool use amongst the targeted student groups, as well as identifying potential candidates for the follow up interviews, as described above.

A paper-based questionnaire was used to aim for as many responses as possible. The questionnaire was distributed during class time, with the help of the students' lecturers. Access to students was entirely dependent on the members of staff and their willingness to give up some of their teaching time for us to go into class to distribute and collect the questionnaires. The design of the questionnaire will be described in more detail in the "Data collection instrument" section.

The survey gave the students the option to volunteer for a follow-up interview, for which each participating student would be paid £5.

3.1.2. Interviews

Semi-structured interviews were conducted with two groups of respondents: students and members of staff.

3.1.2.1. Student interviews

The follow-up interviews were structured around the questionnaire that the students had filled out. This was used as a reference point, and the interviewer asked further detailed questions about the respondents' use of tools for learning and recreational use. The interviewer followed points of interest as they came up, and guided the interviewee to various areas for discussion indicated through the questionnaire answers.

Table 2 – students interviewed

	Social work	**Engineering**
Pre 1992 University	1 x BA Social Work	1 x BSc Civil engineering 1 x MEng Aeromechanical Engineering
Post 1992 University	3 x BA Social Work	2 x BSc Audio Technology
Total	4 students	4 students

3.1.2.2 Staff interviews

Interviews were carried out with eight members of staff across both institutions (see **Table 3 – staff interviewed**). Respondents were recommended by the key contacts previously described.

Table 3 – staff interviewed

	Social work	**Engineering**
Pre 1992 University	1 x Lecturer 1 x Technical support	1 x Faculty manager/lecturer
Post 1992 University	1 x School manager 1 x Lecturer 1 x Technical support	1 x Lecturer 1 x Technical support
Total	5 staff	3 staff

The aim of the staff interviews was to elicit thoughts from practitioners on the use of e-tools, both current, potential and 'wish list', and whilst taking into account use of pedagogies, support and institutional issues and potential strategy and policy issues. So whilst a lecturer may talk about pedagogical use of tools with their own students, it was thought that technical staff were more likely to see what recreational tools students were using as they were likely to be called upon by students to help with tools, or as they have a more 'invisible' role that they would make observations on student behaviour that may be hidden from the lecturer. Views on barriers and enablers would also be enriched by this mix of staff and perspectives.

The interview questions can be found in Appendix 2.

3.2. Data collection instruments

3.2.1. Questionnaire

The questionnaire was comprised of the following sections:

Section A – Personal details
This section included age, course being taken, internet access available, and current ownership of mobile, personal and computing technologies such as mobile phones or MP3 players.

Section B – Use of technology on their course
This section was concerned with respondents' use of technology in their chosen course of study. Questions included asking about VLE use in their modules, plus frequency of use of a range of tools such as digital cameras, podcasts, simulations, text messaging or social software.

Section C – Use of technology for own learning
This section aimed to gather data on technologies respondents may be using for studies or other learning, but using their own tools rather than ones provided by their institution as in Section B. Questions again referred to e-tools such as social software, blogs, Second Life, text messaging or chat, Google, or personal hardware.
At the end of this section there was a direct question as to whether or not they would like to use more of these tools for their coursework.

Section D asked questions about the respondents' use of technology for other purposes (i.e. recreational use). The e-tools asked about are similar to the other sections. This was designed to elicit general usage to see if there was a significant difference between their learning and non learning use of these tools.

The full questionnaire is included in Appendix 3.

It was clear to us, from our own knowledge of the students and from the literature, that in general students would not understand terminology such as 'informal learning', so we aimed to ask questions that would give us insight into their activity. We could then draw out of the data instances of formal and informal learning and specific tool use.

3.3. Respondents

3.3.1. Questionnaire respondents

The survey was distributed to 160 Level 3 students on Social Work and Engineering courses at both institutions. Table 4 gives a breakdown of respondents who completed the questionnaire.

Table 4 **–** breakdown of ages across the 2 subject areas. Detailed results can be found in Appendix 4.

Engineering (114 male, 16 female)	**Social Work** (7 male, 23 female)
GCU Engineering (BSc Hons Engineering/Audio Technology) = 59 Strathclyde Engineering (MEng Electrical and Mechanical/Aeromechanical) = 71	GCU Social Work (BA Hons) = 21 Strathclyde Social Work (MA Hons) = 9

Age across the subject areas was as expected, with engineering students being mainly young 'digital natives' whilst social work comprised a range of students from digital native to mature student: see Figure 1.

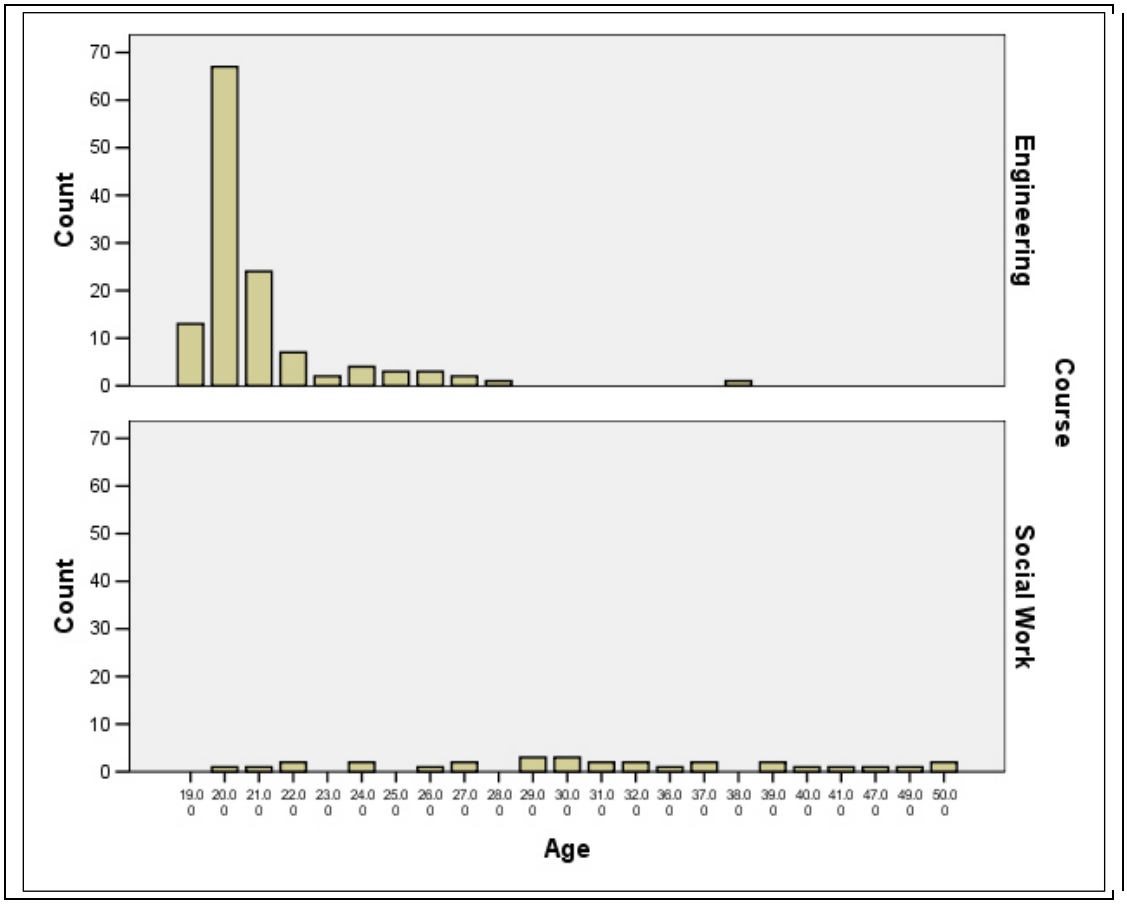

Figure 1: Age and subject area of student respondents to the questionnaire.

3.3.2 Interview respondents

Students: Out of the 28 students who volunteered and gave a contact address, we were able to recruit eight students for interview. Unfortunately this meant that we did not have enough participants to carry out meaningful focus groups in the way that we wished, therefore it was decided to collect the data using in-depth individual interviews instead.

Possible reasons for low response rate to the interview request could include a similar problem we had in recruiting interested staff in the first instance; the time the interviews fell within the semester or term; or the relatively small monetary amount on offer for the students' time, but it is more likely to be the fact that most of the students were "…all surveyed out", as one staff member put it (there had been a number of surveys, for a variety of research interests, carried out at the time of this study across these institutions). This is an issue to consider in any future research planning.

Each of the eight student interviews lasted for around 45 minutes. The interviews were audio recorded and subsequently transcribed. The resulting text files were used in the analysis process.

Staff: Eight members of staff, identified by the primary contacts within the Schools, were recruited at both institutions. Staff were initially asked to describe their experiences of e-learning in their institution to provide some background and historical information as to what were viewed 'current' tools and processes. The interviewer then encouraged respondents to talk about their understanding,

knowledge and views on new and emergent technologies, with a particular emphasis on mobile technology and Web 2.0/social networking software.

3.4. Data analysis method

Questionnaire data were inputted into SPSS, the results of which can be seen in Appendix 4. A chi-square test concerning course, institution, gender and the 'integration question' produced no significant results.

Emergent theme analysis was carried out on the interview transcripts, facilitated through use of Atlas.ti 5 software.

4. Results

Results from the questionnaire can be viewed in Appendix 4. Here we discuss in more detail findings from the interviews with both students and staff.

4.1. Students

Please refer to Table 2 for breakdown of student interviewees.

4.1.1. Which e-tools do students use?

Respondents reported making extensive use of a variety of e-tools such as mobile phones, email, MSN, digital cameras, games consoles, and social networking websites (See Figure 4). Much of this activity was not unexpected as hardware, such as the ubiquitous mobile phone and MP3 player, has quickly risen in popularity and familiarity, as can be seen from the literature and the media, or from observing any group of today's HE student population. Popularity of hardware owned by students is shown as a tag cloud in Figure 2. From the interview data the same can be said for tools such as MSN messenger for informal use, which again we found to be a very popular tool much used and generally preferred to the use of, for example, email. However the survey data does not necessarily reflect this. It became apparent that many respondents were completing Section B of the survey as if it was Section C (tools for informal learning) or even Section D (tools for recreational use). Subsequent interviews have allowed us to clarify some of the data.

Figure 2: Tag cloud showing popular hardware ownership

Tag clouds were generated from percentage use recorded in the questionnaire. This visual representation shows those tools with a higher percentage in a larger font. This visualisation, an idea taken from social software 'tagging', helps to quickly see where the larger usage differences lie.

What we are perhaps less familiar with is how students are using the more recent and informal social software tools and services to support their learning. Current social networking tools that respondents reported in the interviews include popular sites such as Bebo, MySpace, Flickr, Wikipedia and YouTube.

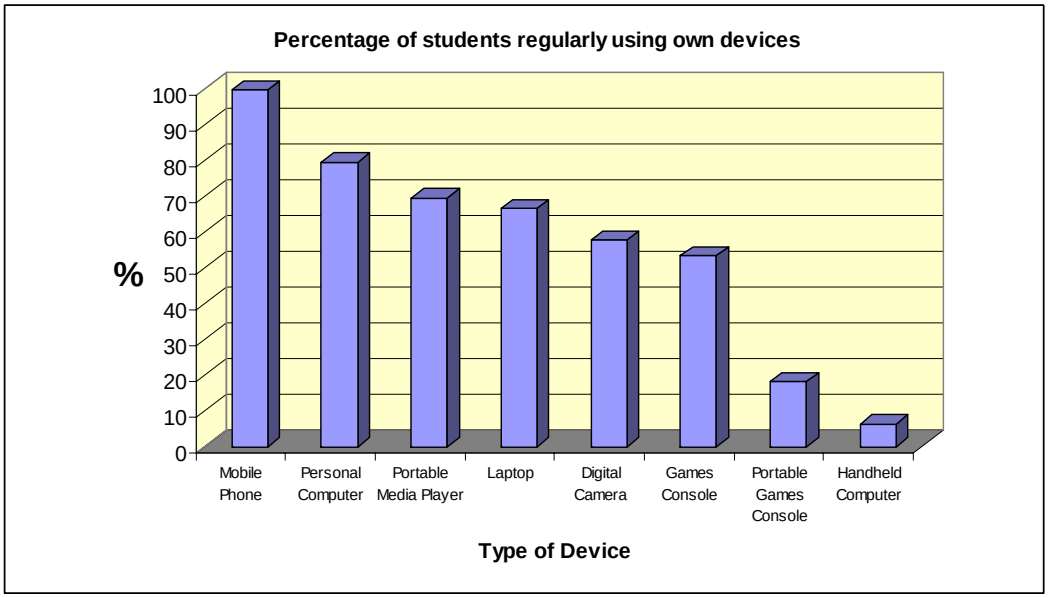

Figure 3: Section A: hardware owned and used regularly

4.1.1.1. Use of 'old' digital technologies

Mobile phones

The majority of students now own at least one mobile phone. This can be seen from survey results with 99% ownership. From the interview data is was apparent that students are using these devices for a mixture of communication and multimedia purposes. All the student we spoke to, regardless of age, reported this mix of functionality.

Respondents discussed their phone use in terms of contacting friends and family, or as a way of their family keeping in contact with them. Fifity percent of respondents also reported using their phone to contact other students for both recreational and study purposes. From the interview data this activity is shown as, for example, organising to meet (either online or face-to-face); discussing their study; and collaborating on projects or assignments. They also contacted each other to look for, or offer, support in their studies – the 'pre exam panic' often being quoted as a driver.

Preferences for mode of use for communication – voice calling or text messaging – appears to depend on a mixture of personal preference, suitability of the medium, time of day the communication takes place, where the communication takes place, or who the communication is with. These forms of use were mentioned being used with regards to both formal and informal use for learning and recreation.

Where their phone had the functionality respondents stated in interview that they also use it for a variety of other tasks, such as listening to music, taking photos, or playing games. Whilst around half of the students were open to the idea of using their mobile phones for listening to learning related podcasts, for example, others were against having study materials on their phones as the phone was viewed as a pleasure item, not 'work'. However all of the Strathclyde engineering students did report using their phones to take photos for study purposes, specifically of their project work.

PCs and laptops

Much of the respondents' study work was done with the help of a computer. Again this was not a surprising outcome. Computers, both desktop and laptop, are the main technology of choice for learning and for supporting social activity especially when the students are at a distance to one another. They are also the main hardware choice for access to social network sites, though one participant told how he accessed the internet on his Play Station Portable (PSP), whilst another participant used his smartphone.

From the interview data it became apparent that recreational use of computers was widespread, covering both communication and entertainment aspects. Participants did not generally distinguish between communication activities for study or recreation, the two often merging in the same 'session'. Equally contact between friends, family, students, and even staff, was intermingled.

Most of the participants owned their own computer, with 79% ownership of a desk top computer and 66% ownership of a laptop. Those participants who did not own their own generally stated that they used that of a member of their family or that they used computers on campus, either in labs, the library or a campus based learning café. Some of the participants had inherited a computer

from an older sibling or a parent, whilst others had bought new ones especially for use during their studies.

Those with laptops were mixed on their willingness to take their laptop with them to campus. This was partly due to the weight of the laptop – especially if also carrying notes, books, or sports equipment – but also partly due to security concerns or worry that it would get damaged. Staff also commented upon this aspect, stating that the institutions did not provide anywhere for students to lock up their possessions during the daytime. The computer was generally seen as the student participants' main study tool, utilising a variety of software and add on hardware tools.

A further observation on hardware usage that makes a link between existing digital technologies and new social software was highlighted by participant's comments on dealing with their own data. Students use USB keys (Creanor et al, 2006; Conole et al, 2006), but one engineering student reported using his iPod for storing and transporting coursework, pdf files, etc. He felt that a USB key may easily be lost, but that he would always know where his iPod was. A number of other participants reported using phones/smartphones for similar purposes (where a memory card was available). This ability to carry their work around with them or access it from a network (via MySpace or YouTube for example) and make use of it from a variety of hardware tools (personal or institutionally provided) was much valued.

Use of MSN

MSN is still popular as an instant form of communication and is often quoted in the interview data as being used between, and whilst performing, other functions/activities on the computer. Use of chat tools was very much a case of personal preferences or suitable tools for the job, depending upon subject area or what was required. Twenty six percent of questionnaire respondents reported daily use of instant messaging during their informal study, with 31% for recreational use.

As with participants not distinguishing their study and leisure activity, so they sometimes did not distinguish between use of MSN or use of a similar chat tool provided by sites such as MySpace or Bebo. To them a 'chat tool' was just that, whoever the vendor or service provider was. This explains the mismatch between the interview data showing seven of the eight student respondents using some form of chat, whereas the questionnaire data appears to be lower.

Some participants expressed preferences for communication software that allows them to see if a contact is online or not, whilst others found that this could feel intrusive. MSN and other real-time (synchronous) forms of communication were used for instant, informal interaction. Interactions described included using these tools to find each other on campus when labs and classrooms were dispersed, as well as expected use such as letting each other know about class changes, or discussing coursework. Again this kind of use is already well documented elsewhere, such as in the recent reports from Conole et al (2006) and Creanor et al (2006).

Some subject or discipline differences did show in use of instant messaging, which may have implications for use of other tools. For example a social work student described how she would not attempt to discuss a patient case over MSN due to potential ethics issues and that it was, due to its very nature, only of use to her for short messages, for example to arrange to meet up. An engineering student commented that whilst they used MSN to socialise and discuss course work, they could not use it for any in-depth messages as its format was not

suitable, for example it would not take equations, therefore instead they would use email or the VLE, or meet up physically in their engineering lab. Use of SMS also displayed this limitation.

Email

Email, on the other hand, was reported in interview often for sharing documents and other content. Data about email was not collected in the questionnaire.

Another preference for using an asynchronous form of text communication was that messages could be 'left' for someone to pick up if they were not available for synchronous communication, if they were not making themselves available at the time, or a message was being sent at an unsociable hour. Another reason quoted for use of email was when trying to contact those who, for various reasons, had not yet moved to using synchronous or social network tools. Interestingly this type of comment did not seem to have any age bearing. Young peers of respondents were just as likely to not use Web 2.0 tools as older ones.

4.1.2. What are students doing formally that supports their learning?

Respondents reported making most use of an institutionally provide VLE (57%), Google (61%), and other unspecified websites (69%) as their main e-tools for study, as provided by or encouraged by the course of study they were on. Discussion groups (8%) or chat (6%) did not feature highly in formal learning, though the use of mobile phones (41%) and messages boards (15%) faired better.

Participants' use of a VLE or institutionally provided websites was mixed. Their views are reported here as background to student activity. In the interviews participants talked about how they and their tutors use the institutional websites, such as the VLE or specially developed sites (e.g. 'Clydetown', a project which was originally a collaboration between the Social Work staff teams across four Universities in the West of Scotland, designed to take advantage of the then new Metropolitan Area Network; available at: www.clydetown.gcal.ac.uk). These seem to be accepted by students as part of their learning experience. There were a variety of uses reported, and a variety of perceptions about this use.

The use of the VLE or website appears to depend on how much the individual tutors promoted and used the site. Where tutors were engaged, and where a lot of resource and opportunity for discussion is offered, then students were generally positive about using such systems. Some tutors however were reported by students to make little use of the VLE, therefore the students did not use it either. Instead they reported finding their own ways of contacting each other and sharing resources, for example through MSN, MySpace, Bebo or personal email.

At the most basic a VLE or website was used to make handouts and course notes available to students, either before or after a class. Students did express a strong preference for being given this option as it allows them to annotate during the lecture, concentrating what is being said rather than on copying what is being displayed.

Though the survey results did not show any great use of the discussion boards (only 8% daily use and 17% weekly or monthly use), during the interviews the majority of student respondents reported that some of their tutors set up discussion areas and used the sites to distribute other resources and materials.

These resources could include, as well as notes, media files for use by the student. For example in social work the students' role play was videoed and the student was given a copy of the video to reflect upon. They then had to submit a reflective report on their performance for assessment. One student stated that it would be useful to have the videos online in order to be able to view it from wherever they were at the time of study, but as long as these could be made private, or shareable to only those whom the student wished to share with. Sharing with others was seen as a useful way of getting an external opinion on their performance, picking up on clues that they would not have noticed themselves.

The engineering students talked about their use of the institutional VLE. The social work students mainly reported on their use of the Clydetown system. Where this was not being used (for example depending on the module being studied) the social work students used the institutional VLE. Contact with tutors was often via discussion boards in the VLE, though again this depended on the tutors' level of engagement.

4.1.3. What are students doing informally that supports their learning?

Students are:

- socialising and creating communities
- supporting each other through those communities
- sharing and creating resources
- organising their learning and their groups.

The main use of Bebo, MySpace, Wikipedia or other similar e-tools reported during interview were for communication, socialisation, information gathering and creation purposes. Students talked about how they used such sites for keeping in contact, making new contacts, or for re-establishing relationships. Participants also reported their use of these sites for creating, sharing and uploading content. Figure 5 shows the popularity of a range of e-tools reported in the questionnaire to support learning.

From our interview sample much of the communication aspect was done through MySpace, Bebo and YouTube. Chat facilities in these programmes were interchangeable with use of MSN messenger and often the term 'MSN' was used to indicate the chat facilities in the above software.

Learning activity (or activity that supports learning) and socialising were often mixed together in these spaces, for example one student told about how a single message sent through MySpace would "...usually include a link or two to a website, a bit about the course and then just berating someone on how silly they looked in a photo". This type of exchange shows how use of these tools is ubiquitous and how skills have developed that allow for easy uploading and sharing of content for some students. It is part of their everyday life for both study and socialisation.

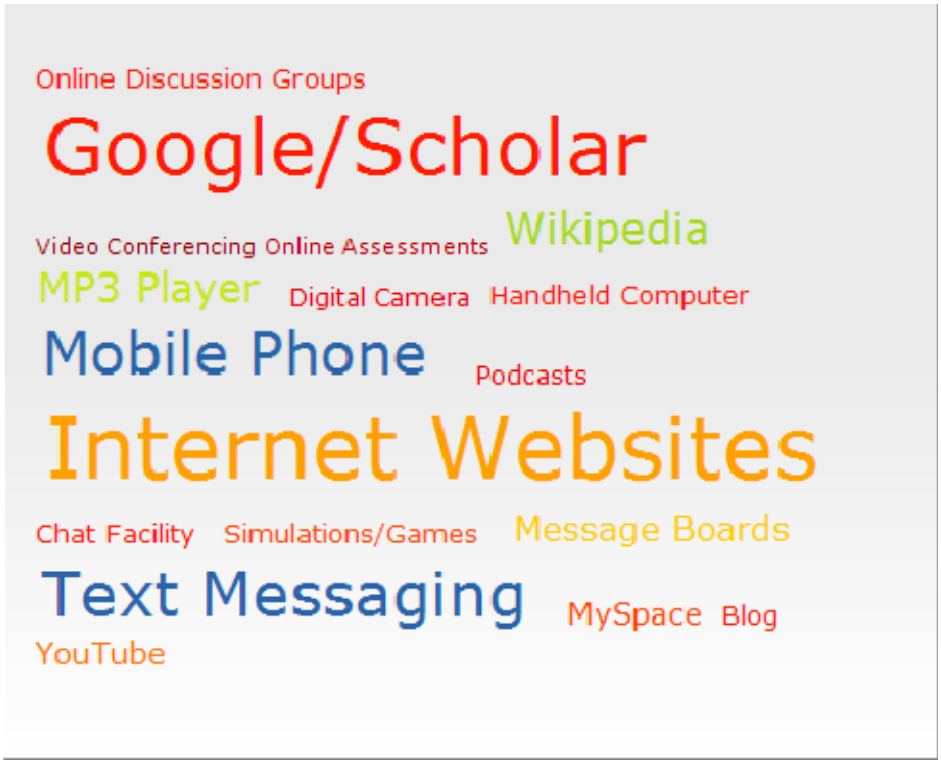

Figure 4: Tag cloud visualising percentage of reported use of e-tools to support learning

Content sharing sites and services, for example Flickr (with daily use by 17% of respondents) or BitTorrent (with 26%), are becoming popular. Engineering students used these for downloading specialist software, both subject areas reported use of these sites to download music or video. The interview data told that photo sharing however appears to be carried out more via social network sites (MySpace) rather than specialist media sites such as Flickr.

As with other e-tools, participants did not distinguish use between information sites, for instance when students talked about searching they discussed looking at Wikipedia, Google, Google Scholar, Yahoo, Athens, university library catalogues, and a range of subject specialist sites suggested by their tutors, peers, or found themselves.

Table 5 – Section B Students' use of information websites on their course

	Daily	Weekly	Monthly	Never	Total
Websites	69% (110)	21% (34)	3% (5)	7% (11)	160
Google/Scholar	61% (97)	25% (41)	5% (8)	9% (14)	160
Wikipedia	25% (40)	32% (51)	20% (32)	23% (37)	160

Table 6 - Section C students' use of information websites for their own learning

	Daily	Weekly	Monthly	Never	Total
Websites	52% (81)	28% (44)	6% (9)	14% (22)	156
Google/Scholar	41% (63)	28% (44)	7% (11)	24% (37)	155
Wikipedia	25% (39)	28% (43)	20% (31)	27% (42)	155

This use also extended into the social or recreational sphere with students following links serendipitously and finding information not related to their study but of equal interest to them. Interestingly none of the participants reported

contributing to sites such as Wikipedia, or to making their own comments on website postings, even though they found comments and ratings useful themselves where others had done it. In a similar survey carried out at GCU only 11.8% reported having contributed to Wikipedia (Chalmers, 2007).

Opinion was divided amongst staff and students between acceptance of sites like Google and Wikipedia as to whether or not these were considered valid sources of information, but students are very aware that these sites may not always give correct information and therefore are often used instead as a beginning to the search process. One student participant talked about how he would use Wikipedia as a quick staring point, then used Google to gain a range of different perspectives to validate what he found. He would then go to more specific, subject related websites, such as Athens, to search further.

Students share information sources with peers and work colleagues. One student told how, on coming across an interesting article or paper, he would email the article or the link to colleagues and other students to share. This student had not considered using a site such as MySpace, but interestingly he was one of the small number of older students we interviewed.

Another participant related how a fellow student had scanned some past papers and had posted these to their Bebo site which were then shared around the class. This was done in reaction to not being provided with papers by their tutor when requested.

A couple of participants reported that during one project, because the VLE lacked the functionality they required in order to share information, technical manuals, photos and discussions one of their group had created a website for them instead. However when these participants were asked if they would consider using a ready made site such as Bebo for this purpose they initially expressed doubts that such a site was useable in that way, partly for technical reasons and partly conceptual in that they saw this kind of site as being essentially for socialising, not study. This lack of understanding of the functionality of social software sites was common across many participants; however some, during the course of the interview, began to express ‘aha’ moments where they began to see links between their current study activity and their social activity.

One student was explicit in saying that they were going to try this idea out. Another participant thought that it would be useful to be able to link sites such as YouTube to the VLE, in order to be able to share and upload videos and other large media files, such as project files or their own practice videos.

One social work participant however told of how she would like to have a Bebo-style course website where all her fellow students could log in, socialise via discussion boards or chat, have access to shared areas to collaborate on coursework, and to share information on study or recreation. She also explained how she would like to use the Bebo blog as a personal journal to reflect on life and study, but that she hadn’t started doing that yet as she wasn’t too sure how to do this.

4.1.4. Why were students using specific e-tools?

Respondents stated that their preference for use of e-tools was generally dependent on circumstances. They use e-tools indiscriminately to support their learning and do not generally separate formal and informal learning activity.

For example one of the social work students was keen to have audio recordings of lectures to upload to her iPod for later reflection whereby the recording and the lecture notes could be viewed together for further exploration and understanding, especially where the topic may have veered from the notes due to question and answer sessions. An engineering student however pointed out that an audio recording of a lecture that was about maths and equations, i.e. one requiring a very visual presentation, would not be of much use.

In contrast, some students expressed preference for not wanting to use recreational tools on their course. One engineering student said that he couldn't see the point of things like blogs. Why would he be interested in what someone else had done that day? Another engineering student thought it was great to be able to see what people had been up to and so regularly used her Bebo site to check this.

Where specialist software and hardware was required for formal learning the students generally accepted coming into campus to use the systems and software provided by the institution, if it was not possible to own these themselves. Reasons for not owning certain tools were generally the high cost of these.

Provision of computers on campus in labs and libraries with reasonable network speeds was in the main deemed to be good at both institutions (see Table 7 for a breakdown of student access patterns). Participants who did not carry a laptop with them were able to carry out their work between classes. However some students expressed concerns that there could be competition for computers at busy times, such as assignment or exam time, and that they found it irritating when others were seen to be playing games on these computers rather than studying.

Table 7 – Internet access availability and use by student respondents

Internet access available:	**Yes**	**No**
Access at home:	145 (91%)	15 (9%)
Access on campus:	**Yes**	**No**
Library	139 (87%)	21 (13%)
Labs	132 (82%)	28 (18%)
Campus Cafe	38 (24%)	122 (76%)
Other	22 (14%)	138 (86%)

Those participants who required specialist software, such as the engineering students, stated that they were well provided for by subject based labs and were relatively happy to accept that the labs provided only these specialist e-tools and not internet access. Participants accepted that these were provided for a particular job or part of study. This feeling of 'tools for the job' cropped up in relation to most of the tools discussed, both hardware and software.

4.1.5. Would the students want to use more of these tools or use them in other ways? Do they want institutions to provide them?

Forty five percent of questionnaire respondents stated that they would like to use more e-tools formally on their courses, 42% were unsure, and 13% stated that they definitely would not like to use informal e-tools in their study (see Figure 5). However it became clear during the interviews that reluctance to use more e-tools, or social software, was often due to either not understanding the nature of the tools, or a misunderstanding of some aspect of the tools, such as privacy and security, or for example a conceptual lack of understanding on the collaborative nature of wikis.

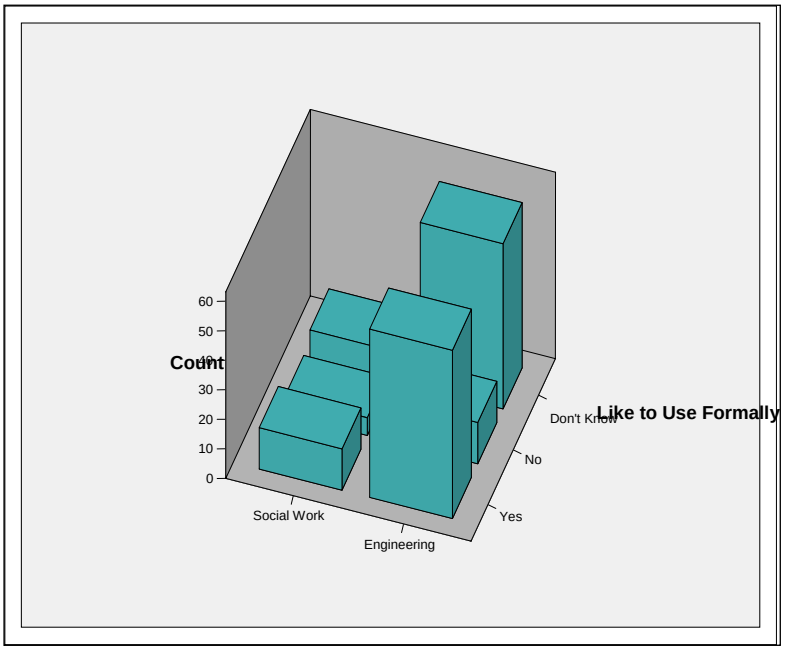

Figure 5: Respondents' attitudes to making more use of informal tools in their formal study.

Students had clear preferences for particular types of tool. For example, engineering students looked for specialist tools such as modelling software, whereas social work students looked for communication and resource repository tools. Both groups were less concerned with who provides the tools – if provided by institution they will use them, if not they will use their own.

For many of the students, lack of familiarity with tools was a major barrier to their use. On the other hand, where students were already regularly using tools, such as Bebo and YouTube, they readily accepted that these tools could be used to support their courses.

Disciplinary difference did result in different barriers to tool use, for example engineering students described how problematic sending equations and formulae via text based tools was.

Some of the engineering students tended to see that Web 2.0 tools were for social and recreational purposes only and therefore would not be suitable for study. However once examples of use of tools were discussed a little more, some respondents began to see potential in use of Web 2.0 tools to replace some aspects of VLE use or provide extend functionality.

Social work students all expressed a wish to have more institutionally provided tools such as "Clydetown". They also expressed a wish to be able to share information and resources more than they currently could, and to be able to choose who they shared these with. They also recognised the potential problems with issues of ethics if reflecting upon, or sharing, anything that may contain patient (or service user) data.

In general students did not know how to maximise the potential of Web 2.0 for learning and for many their digital literacy skills were fairly low.

4.2. Staff

Please refer to Table 3 for breakdown of staff interviewees.

Staff views on e-tools were mixed and varied. As with students, views often came down to discipline difference, or to levels of understanding of the nature of tools and how they could be used. Given the small sample size however, we have to exercise caution in our interpretation of these views. It is not possible to generalise these and more data would need to be gathered in order to do so.

The sample size for staff was also problematic for identifying potential differences across the two institutions and no conclusions can be drawn about different uses of e-tools across these.

4.2.1 What are the staff's experiences and perceptions of using e-tools to support learning within the educational domain?

Social work respondents, both students and the five members of staff across both institutions, expressed a requirement for communication and interaction. Student and staff skills in using technology were the main features of discussion with the social work staff. These members of staff were generally enthused by any technologies which supported communication, interaction and problem based learning (PBL).

There was an acceptance of the value of making a move to using more virtual communication tools as these were seen as part of current and future professional practice, therefore these skills were transferable into the workplace. The online environment was deemed to suit the demographic of the students as many had family and work commitments and so required flexible learning opportunities. Resources such as 'Clydetown' were quoted by social work staff across both institutions as being extremely successful in fulfilling these requirements, though staff were also aware that students were finding their own ways of communicating outside of the institutionally provided environments.

Social work staff at both institutions were encouraging students to make use of opportunities for discussion and interaction amongst themselves. The nature of the preferred learning and teaching method employed (PBL) was seen to lend itself well to informal learning opportunities. Some staff actively encouraged students to share their mobile phone, email, MSN and other contact details with each other in order to foster a supportive community of students.

Engineering staff instead expressed a need for face-to-face communication and interaction within their subject area. The robustness and stability of tools were also strongly featured in these interviews. Tools had to be suitable for the work at hand. Though engineering staff were knowledgeable and enthusiastic about current trends in e-tool development there was a general feeling expressed that unless tools such as Web 2.0 proved to be reliable and interoperable then there was no great drive to move to these for teaching and learning where other suitable tools were already in existence. Where the great interest for engineering staff lay was in the development of better hardware to support practice, for example wireless and mobile technologies were seen as the next step forward, as long as VLE manufacturers solved interoperability issues to allow these devices to be used ubiquitously.

4.2.2 What e-tools are staff currently using?

Generally the teaching staff we spoke to were in the main making use of an institutionally provided learning environment, either a VLE or a site such as Clydetown. For the engineering staff they were using these mainly for uploading factual materials and resources for the students, for making revision materials and past papers, assessment, or for administrative and organisational purposes. Alongside the usual administrative purposes, the social work staff were using the VLE for discussion and making resources, though not to such a great extent as the engineers. They were also making great use of Clydetown, where this was appropriate for the particular cohort of students. This environment offered media and discussion combined with textual and other resources.

Students in both subjects were set group activities for which staff felt that they did make good use of the VLE for sharing information and resources and for discussing projects. Students also appeared to use the VLE for arranging face to face discussions and project meetings, though the survey results do not necessarily bear this out.

This contradiction appears to be a difference between overall use of communication tools as perceived by students against the frequency of communication as measured by staff. The students are using 'other' tools much more than staff realise. What constitutes 'a lot' to staff is in fact only a small percentage of overall communications by students using discussion boards **plus** mobile phones, MSN, Bebo and such similar external tools.

All of the staff interviewed were aware of the range of emerging e-tools that the students had been surveyed on, but most of them had had little chance to explore these. Some staff did report how their students had alerted them to some of the Web 2.0 tools that the students were using for their leisure activities. For instance, a social work lecturer described how her students had suggested that she used MySpace as an alternative to a social work community website that had ceased to exist and this is an activity and site that the lecturer wishes to use again.

Other tools quoted as being used were specialist tools, such as audio recording systems. Discussions around these took place with support staff from both institutions who support labs and focused on support issues and ideas for potential technical enhancements to the tools. There was a lot of enthusiasm from support staff for the introduction of informal, Web 2.0 and personal or mobile devices, though frustration that there was neither the funding nor the motivation for teaching staff to introduce these to any great extent.

4.2.3 What is the staff perception of the educational rationale for using e-tools?

The Clydetown environment was based around the principles of problem based learning and was used extensively in several first year modules in social work in both institutions. Observations made by the social work teaching and management staff paralleled its use to the students' use of Web 2.0 tools in that the students continued with similar processes of communication and interaction, problem solving and collaboration via other means when Clydetown was discontinued in the students' second year.

Generally the engineering staff across both institutions talked about tools in terms of their affordances and stability. There was a general feeling throughout engineering that the institutional VLEs provided stable and secure tools so there was no need seen to use anything other than these. This was with the proviso that the companies continued to develop these tools and offer new functionality in

the future. There was a very pragmatic view expressed that Web 2.0 tools were seen as ‘flash in the pan’, just a fad that was not worth the time and effort to redesign courses around or invest time and funding in. Building a good infrastructure to support connectivity and access was seen as more important, though this view was not universal. There was also a perception that whilst the internet was a useful resource, it could also be a ‘time waster’. What is seen as ‘recreational’ use of hardware is not generally acceptable in the engineering labs.

Staff in both subject areas did however actively encourage their students to swap contact details. The two social work teaching staff related how their students had set up a ‘contact tree’ to relay information to each other on organisational issues such as cancelled classes or a relevant tv programme being shown. Tools used were email, mobile phone, MSN and social networking sites (MySpace, Bebo, etc).The staff themselves however limited their input to just providing an email address or mobile phone number, and making sure they had details for the students.

One lecturer related how she had tried to use clips from YouTube to illustrate a lecture but that she initially was given incorrect advice on use of the technology in the particular lecture theatre. She eventually got it working and stated that the students were very enthusiastic and that she will be exploring more ways in which this can be used. (The class was looking at how service users/patients may be able to use tools to find information and support.)

Students were encouraged to form informal study groups to support each other. It was felt important that students do this as if the student has struggled with a concept they are better equipped to explain the problems to another student than the lecturer may be, as the student understands where the conceptual problem lies. Generally teaching staff did not mind how students went about their communication, and it was quite accepted that they would more than likely be using their own devices and social websites to do this.

Attitudes to shared information, such as can be found on Wikipedia, are mixed with some staff accepting and encouraging use of it whilst others not. However most staff are in agreement that students should be taught the skills to make informed decisions themselves as to what is valid and what is not. The data from the students supports this in that they are generally aware of potential issues.

Staff in general were not convinced that e-tools such as Second Life offered much extra educational benefit compared to the time and expense of creating virtual worlds and simulations. Second Life was generally viewed as an environment for meetings and advertising and was perceived not to have much educational value. Students were generally unaware of Second Life more than having heard the name.

Many of the students we spoke to are making some use of their own tools to socialise and network in personal and public spaces, and in doing so are actually supporting their learning in that they use these tools to communicate and share information and resources between themselves and their peers, even though they did not necessarily view this themselves as ‘learning’ per se. However there was little evidence that institutions were providing this functionality formally. On an informal basis students are generally being encouraged to share their contact details, but from the staff viewpoint this was seen more as a way of the students passing organisational information rather than for learning purposes. Staff were aware that students use their own devices to organise themselves, but have little knowledge of what constitutes communication for learning. This is not seen as problematic though as we know that students have of course always

communicated outside of the class, invisibly to the teachers. It is possible that use of Web 2.0 may make this more convenient for the students and may also provide a way of keeping a record of such communication that may be used at a later stage in the students' development and learning.

Subject differences showed up in the study of how tools were perceived. Engineering staff and students were more concerned with the "correct tool for the job", whereas in social work they viewed tools more as the process than the actual tool, for example they would refer to the process of discussion rather than an interest in the technical details of the tool. It became clear that different pedagogies required different use of tools to support the learning processes. Social work required discussion and sharing in a subject that is based more upon shared understanding and negotiated meaning, whereas engineering was based more on the sharing and understanding of facts and figures.

Use of older technologies was widespread and use of a VLE or equivalent was embedded, though to a greater or lesser extent depending upon the teacher's engagement more than the institutional provision. Students generally had an acceptance of the tools they were provided with and would use these, as long as the tutor made good use of them by providing resources or activities within the VLE. Where the tutor engagement or the tool lacked functionality, the students would substitute with their own preferred tools and would negotiate within their group through peer pressure which tools that particular group would make use of. They appeared to support each other in learning how to make use of the tools where required.

4.3. Use of e-tools to support learning: Examples from the data

We can now explore examples of the use of social software and personal, mobile devices from the collected data.

These examples are devised from the interview data. These examples mainly come directly from the students and relate to their own tool use.

4.3.1. Example 1: Collaborative design project

Students set up their own website to share information about a group project which involved the design and construction of a small aeroplane. They used the site as a shared space in order to post data, diagrams and images of their parts of the project, to keep themselves updated, and to discuss design details and organisational aspects of the project. They also made use of SMS, MSN and email to share and communicate. This work was not assessed in itself, but the final project was.

4.3.2. Example 2: Sharing and reflecting on practice

Students carried out role-play scenarios of client interviews. These were formally recorded by the tutor, but then provided to the student to view and reflect on by him or herself. A written report of reflection on performance was then submitted for assessment. The students reported sharing these videos between themselves with one student reporting having uploaded their video onto YouTube.
The sharing of the videos and reflections was not part of the formal process but students did this in order to gain feedback on their performance. Students reported that it would have been more desirable if they could have somehow shared the videos in the VLE to give them better security and overcome potential ethical problems.

4.3.4. Example 3: Data management

Students showed creative ways of storing and managing their own work and documents. One student reported how he used his iPod as a USB stick as well as it being his main personal media player. He would download documents from the VLE for later reading, especially if he was not sure he would be able to get to a networked computer for accessing the VLE remotely. He knew he had the materials to hand. Many of the students reported making use of the storage on their phones to carry about their work. Some uploaded materials and work into their MySpace or Bebo page in order for it to be available to them from any networked computer, either on or off campus.

4.3.5. Example 4: Resource creation

Students reported how they would often use their mobile phone to take photos for projects. These may have been photos of work in progress, in the case of the engineers, or of an example of an area the student was on placement, as in the case of social work. These photos were uploaded into MySpace or Bebo personal sites and other students accessed these from there.

4.3.6. Example 5: Peer supporting assessments

One set of students had organised themselves into a small support group in order to critique their assignments before submission. They gathered into a trusted group, not necessarily all students in their own class, but friends, and between them, via email or MySpace, circulated their essays-in-progress. They would then read and offer a critique of the work to each other in order to help each other develop their own thinking. The students had considered the problems of plagiarism, but had decided that as they were not all writing the same essay then this was not an issue. This group of students also used SMS and their social software sites in the run up to exams to offer moral support during revision.

4.3.7. Example 6: Sharing past exams via MySpace

Where past exam papers had not been provided when expected, one student had borrowed papers from the library, scanned them into PDF format, and had then posted them onto their MySpace page, the URL of which was then shared around the class. Discussion on the content of the paper also took place through the site. The student who reported this did express concern over copyright issues and believed that if they had been given the papers as expected then the student who did the scanning would not been put into this potentially difficult position.

4.3.8. Example 7: Use of YouTube in the formal classroom setting

One teacher reported that she had used videos found in YouTube to show in class in order to stimulate discussion around a current issue within the profession. The students found this mix of lecture and media stimulating. It is unclear if this interest was partly to do with the novelty factor of a teacher using such a website, or if it was due to the re-design of the lecture, i.e. the mixing of media to make for a more stimulating environment.

4.4 Conclusions from the results

Whilst it is problematic to draw clear conclusions from our small sample sizes it can be seen that our students, of whatever age, own a wide variety of hardware and are regular users of communication, recreational, and gaming e-tools.

There appears to be less support for these tools in the two institutional environments sampled. Provision and support of institutionally provided tools, such as a VLE, is high and these tools are now ubiquitous, though the extent of use can be mixed depending on course and the individual tutors. The use of new

e-tools in teaching however appears to be ad hoc and does not necessarily match the student expectations or needs.

Subject differences in the data point to there being differing needs for differing suites of e-tools, for instance whilst the subject of social work requires communication tools, engineering is more concerned with the sharing of data and information.

Conceptual understandings of newer e-tools are mixed, with misunderstandings of the potential functionality of these tools inhibiting experimentation and innovation. However where e-tools did not appear to provide the students with the functionality they required, for example easy-to-use shared space in a VLE, then the students showed themselves to be adaptable by using the tools they already owned and were regular users of, if they could overcome those same conceptual misunderstandings.

Other barriers and enablers to the use of tools also featured during the interviews with both staff and students. These issues are discussed next.

5. Barriers and enablers to integration of e-tools within education

Many factors may impact on the uptake and use of e-tools to support learning in higher education. Collis (1995) suggested four broad types of barriers – socio-cultural, organisational, pedagogic and technological. These factors are interrelated as for example pedagogical issues have associated technological and socio-cultural dimensions. Table 8 below outlines key barriers drawn from the data under the four categories of pedagogical, cultural, organisational and technical factors, and Table 9 outlines potential enablers.

Table 8 – key barriers in the use of e-tools to support learning

Key Factors	**Barriers**
Pedagogical	Lack of digital literacies in both students and staff Curriculum fit Suitability of the tools to support the desired interaction Lack of face-to-face interaction
Socio-cultural	Students' expectations and prior experience with e-tools and software Staff expectations and prior experiences Misconceptions on security and invasion of personal space
Organisational	Costs Institutional strategies and objectives Institutional constraints on use of technology Assessment issues Teachers' skills and training
Technological	Technical skills Technical support Interoperability and connectivity issues Availability of existing networks (cable, broadband, wireless) Institutional hardware and infrastructure

Table 9 - Key enablers in the use of e-tools to support learning

Key Factors	**Enablers**
Pedagogical	Affordances of social software to support learning and teaching processes Students' ability to adapt to the tools provided

	Control moves from the institution to the student
Socio-cultural	Students' prior social use of tools and familiarity with these (no training required) Flexibility of space and time Flexibility of choice of tools Current high ownership of personal devices
Organisational	Institutions do not need to provide all the tools
Technological	Remix and mashup technology are increasingly interoperable by their very nature

These issues are elaborated upon below.

5.1. Pedagogical issues

Pedagogical barriers refer to the way and the extent to which e-tools can support the processes underpinning formal and informal learning. Traditionally, formal learning took a passive, didactic approach, whereas contemporary learning theory places more emphasis on collective learning and collaborative knowledge construction. However, the extent to which this approach currently fits with the HE curricula is unclear. Traditional methods of instruction are still very much in place and students and staff may be resistant to shifting their respective roles. Mejias (2005) argues that implementing new technologies in the learning process is straightforward if the goal is to mimic traditional ways of learning and teaching without affecting institutional values; the challenge is in introducing new technologies that reflect the new pedagogical principles that guide our current educational models.

Diffusion of technology into teaching and learning practice creates a number of challenges to which teachers must adapt. For example, Hartman et al (2007) highlight, among others, the following issues:

1. *Shift of the balance of power in teacher-student relationship* – being confronted by new technologies about which students may know much more that they do, teachers may find themselves turned into novices, something that many teachers accustomed to thinking of themselves as the experts might find difficult to face.
2. *Social behaviour structures and patterns fostered by new technologies challenge the individualistic approaches fostered by institutions* – digital natives prefer and expect to work in groups. Their social groups extend beyond people they know directly, and include "friend-of-a-friend" contacts – broad and wide networks of people to communicate, collaborate and share knowledge with.
3. *Teachers' view of technology as "technology" vs students' view of technology as "environment"* – these diverse views influence how teachers use technology (for presenting content, most of the time) and how students use technology (as a tool for exploring, communicating, socialising, to which we should add "participating, remixing, mashing up and creating"). Hartman et al (2007) suggest that the reason why, when asked about their preferences for the use of technology in their courses, "students often report that they prefer moderate use of technology by teachers is not due to their dislike of technology, but rather because they see it as a tool for active learning instead of a tool to facilitate the instructors' presentation of information" (p.66).
4. *Increased dependency of teachers on support staff and students* – another dimension of the shift in the balance of power, whereby the need to understand and apply new pedagogies supported by new technologies

increases teachers' dependency on IT staff, educational and staff developers, instructional designers and their own students.

5. *Technology affects reward, recognition and risk* – tensions between institutional rewards based on research rather than teaching outputs may impact teachers' motivation to experiment with and adopt new pedagogies and technologies.

In today's world there is high demand for flexible delivery and e-tools, particularly network technology, can be a key enabler to the flexibility. The use of mobile and personal technologies can enhance the flexible learning experience and impact on users' motivation and engagement. Any existing information literacy skills that students may have from using e-tools in informal learning contexts can also be classed as an enabler in relation to both pedagogical and socio-cultural factors.

5.2. Socio-cultural issues

The extent to which students currently own and use existing tools and software is an issue that this project sought to address. Although students may have previous experience and expertise in the use of e-tools and software, this experience may be a barrier if there is a mismatch in the students' and staff's expectations in the nature of the use of e-tools and software to support learning. This could be in the extent of communications, both in terms of the amount of electronic communication and the quality in terms of acceptance of non-conventional forms of language such as txtspk in, for instance, blog communications, and even concerning the amount of personal data shared online, especially in relation to formal assessments.

Most importantly, diversity of learners is an issue that must be addressed: students are not a uniform population, not everyone is a technology-savvy digital native, therefore identification and selection of appropriate tools and approaches is a complicated task for the teachers (McGee and Diaz, 2007).

5.3. Organisational issues

There are many barriers and enablers to the use of digital technology in education which could be classed in the organisational category. First, there are of course the costs to the institution itself for providing such tools and software. It could be argued that it is unrealistic to expect institutions to loan students handheld personal devices such as PDAs. In addition, as Trinder (2005) points out, the personal nature of such devices implies that they are not meant to be shared. Second, it has been suggested skills of staff, and especially in Prensky's notion of them as 'digital immigrants', may impact on the use of digital technology. Staff development and support would be a fundamental requirement to enable integration of e-tools into education. A recent JISC publication on Improving Staff i-Skills (Joy and Taylor, 2006) suggests that "there is a pressing need for further and higher education institutions to promote and improve staff i-skills, but this area is under-researched and lacking in guidelines for practitioners" (p.1). Alongside these issues are increasing concerns over issues of plagiarism and cheating involving technology, for example, students using mobile phones to store notes during examinations. The Scottish Qualifications Agency (SQA) (2005) stated that allegations of cheating were up by a third in 2005 to a total of 221 cases and 119 of these cases involved mobile phones.

Institutional changes to technology commitment are also an issue. Teachers may adopt technologies at a different rate – slower or faster – than does the

institution where they teach. This can result in instability and unpredictability which makes adoption risky for teachers (McGee and Diaz, 2007).

In terms of Web 2.0 technologies in particular, their strong underlying metaphors of “decentralisation” and “wisdom of crowds” shift the balance of control within institutions in terms of IT, library and learning resources and other forms of traditionally centralised provision.

5.4. Technological issues

Ownership of various devices such as PDAs, pocket PCs, mobile phones, laptops and portable games consoles by students can influence their uptake in the HE curricula. However it cannot be assumed that all students will have these devices. Interoperability and support for different operating systems is a technical factor that must be considered, as is the existence of wireless networks and potential access issues. McGee and Diaz (2007) note that lack of integrated technology tools is a problem: emergent technologies are not integrated with institutionally-supported centralised tools such as VLEs, which results in multiple log-ins, data input, and result tracking. This requires additional investment of time and effort in use and management of these tools.

Personal choice of devices must also be considered (Trinder, 2005) though not just for mobile devices. What suits one student may not suit another, especially if assistive technologies are required.

Quality control is a key issue that underlies these four sets of challenges. Hartman et al (2007) argue that emerging pedagogies and technologies are increasing the complexity and difficulty of determining quality of teaching in higher education. Collis and Moonen (forthcoming) discuss three perspectives on quality in higher education – instructional quality, institutional quality, and technology quality – and argue that these three perspectives need to converge in order to enable embedding in mainstream practice of new pedagogical approaches supported by emergent technologies. They outline a range of mismatches in quality perspectives from the point of view of various stakeholders – for example quality in terms of processes in the European Higher Education Area; quality from the perspective of senior administrators within institutions; quality from the perspective of those representing a discipline or an educational program; quality for instructors; quality for students; or learning theorists who posit requirements for quality in higher education based on theories of learning intertwined with exploitation of the affordances of technology. Collis and Moonen predict that

> inconsistencies in quality perceptions, even from those representing a single actor group, will result in barriers to successful implementation. The rapid uptake of Web 2.0 tools and dynamics in society at large is no predictor of a similar uptake in formal learning practices in higher education. (p.17).

Key to addressing these challenges is supporting teachers in developing their knowledge and skills in relation to the emerging pedagogies and technologies. Since teachers are the ones who will be directly responsible for adopting and implementing pedagogic innovations involving technology, they must be supported in understanding the affordances of the emerging technologies, mapping these affordances upon learning goals and appropriate pedagogies, experimenting with and evaluating these technologies and pedagogies in practice, and disseminating the results among peers. Discussing various models and approaches to faculty development, Bates (2000) emphasises the need for a systemic approach to teacher support as opposed to what he refers to as “Lone

Ranger" and "boutique" approaches to staff development, which are focused on one-on-one support to individual early adopters and faculty members based on individual requests for assistance. Boutique models are unscalable and therefore do not provide sufficient return on investment. In contrast, systemic approaches should bring instructional designers, staff developers, IT and digital media specialists together under a common strategy and scalable systems and processes for dealing with faculty development needs. Hartman et al (2007) suggest that "such centres may evolve into clearing houses where faculty members can share with each other on a peer-to-peer basis, possibly involving students in the development process" (p.72). They further suggest that institutions will have to adapt organisational structures and policies, find financial and human resources, and create partnerships with learning technology organisations to support and sustain a broader network for improving teaching and learning.

6. Conclusions and recommendations

6.1 Conclusions

This project has explored theories and ideas surrounding formal and informal learning, and has considered what e-tools are or could be used to help support the process of learning.

It became clear during the desk study that the initially proposed idea of integration of informal and formal learning was not in fact desirable as the very process of integration would run the risk of formalising informal practises and may in fact destroy any benefits that informal learning offered by thus doing. Instead what we actually wanted to understand was how tools and processes used in the informal setting could be harnessed to help support the formal activity of learning and teaching within higher education.

To do this we needed to explore what educational processes are fostered by these e-tools, as well as define the e-tools we were talking about. It was concluded from the desk study and during data collection that the tools that offered the most interest were social networking tools, supported by personal and mobile technologies. Whilst discussing this we also acknowledge the roles that 'older' technologies still have to play and do not dismiss these as invaluable, but wish to see how these newer and older tools could also be integrated, for example, by bringing social tools into the institutional VLE.

The desk study provided us with a background on the processes behind informal learning and an overview of how social tools can be and are being used to support socially situated informal learning.

The data we collected provided an overview of how these tools and processes were actually being used, or not used, within two institutions. We also saw a glimpse of how different subject disciplines could make use of tools. The data collection, which focused on tools and how these were being used, showed strongly the differing requirements of two subject areas, and these differences are reflected upon in our recommendations that are included in Section 6.2 below.

An important factor that emerged from the data and the literature review is that of ownership and control of both tools and spaces. This angle was highlighted in the recent LEX (Creanor et al, 2006) and LXP (Conole et al, 2006) studies of the student experience, though it was not explored in detail. Ownership and control

can range from personal (e.g. mobile phone) to public (e.g. Second Life), and from student (e.g. laptop) to institutional (e.g. VLE). The boundaries between spaces and tools become increasingly blurred and confuse the issues surrounding the distinction between formal and informal learning. We proposed a framework for exploring this issue into which could be slotted examples from case studies and our own data to help us explore this further.

What we have learnt from the 'digital natives' in this study is that new e-tools and technologies afford processes with an informal focus on self-direction, communities of practice, collaboration, sharing and even identity exploration. These young, and old, adults are active constructors of knowledge and are self-motivated. These are skills we desire in our graduates and this provides a compelling argument to bring these skills together.

Students have shown that they are adaptable in their use of tools to support their learning and they will use the tools they have if none are provided by the institution. However they do not always realise the potential of new tools and this is an aspect where, as educators, we can help them to develop literacies and strategies. They have also pointed the way for us to equally develop our own understandings and conceptions of processes and tools as our engagement with technologies can have an impact on their experiences.

Digital tools, personal devices, social networking software and many of the other tools explored here all help support learning processes and their use is obviously motivating, therefore, we should encourage the use of these tools and processes within our institutions, amongst our staff and not least with our students to help support formal learning in higher education.

The transformation in the way students use technology in everyday life for communicating, building networks, finding information and much else, is profoundly affecting how technology for learning is viewed. The experiences and expectations of today's learners suggest that with the move towards use of personal technologies and student expectations of flexibility in their learning choices, physical spaces will need to be adaptable. Students will require flexibility of design in order to work collaboratively or individually supported by their own preferences for tools.
However a mismatch appears to exist between student expectations of e-learning and institutional provision.

Additionally, students expect to be granted more individual control and choice over learning environments, learning activities and the range of technologies used. The Saltire Centre (a cutting-edge learning space at Glasgow Caledonian University, incorporating both library and café as well as a range of differing study areas, see www.caledonian.ac.uk/thesaltirecentre) helps to address these expectations by providing a state of the art, technology-rich environment where students can engage in learning activities and modes of study which best suit their personal preferences. It supports both independent and collaborative learning, and gives students the freedom to use their own personal technology devices as well as the PCs and laptops provided.

6.2 Recommendations for integration of e-tools within education

The following recommendations suggest ways in which the use of social technologies (i.e. digital tools, personal devices and social networking software) can help strengthen the links between informal and formal learning in higher education, to the benefit of both. Recommendations are organised under the four key areas – pedagogical, socio-cultural, organisational and technological.

Recommendations on pedagogical issues

11. Embrace the thinking behind the use of social technologies in formal learning contexts

When students use social technologies outside university (in the informal domain) they often engage in activities that would be valued if enacted in formal learning in higher education. For example, when using tools for social networking, students often engage in sophisticated information-seeking behaviours, in peer group collaboration and in the self-generation and the sharing of information and resources. The informal domain appears to be characterised by a world-view that emphasises decentralisation of authority (independence in learning), active participation, contribution and collective wisdom. How can HE capitalise on the informal to support formal learning? For this to happen, teachers and HE institutions must first embrace the idea that learning is about 'social participation' and 'meaning construction' and not just about delivery and acquisition. Only then will HE be able to realise the benefits afforded by social technologies in formal education. The starting point is therefore changes in pedagogy at module and programme level and in organisational processes in HE, not changes in tool use.

12. Support the development of students' skills in social networking in relation to formal learning contexts

Although incoming students to HE might already possess some skills in the use of social technologies they may not have applied these skills in ways that would support formal learning. Hence, it might be necessary to prepare and build students capabilities in this area. One approach would be to redesign modules and programmes so that the use of social technologies and associated networking activities are integrated into classroom practices. This would require that members of academic staff are always up-to-date with technological developments. A more productive approach however might be to focus specifically on developing in students the ability to apply social networking processes with digital technologies in formal educational setting: for example, the skills to set up and use discussion forums, mobile devices, wikis, blogs and other social software for educational purposes. In this scenario, students themselves would choose which software and tools best suit the objectives defined by their academic programmes. The advantage of this approach would be that it leaves control in the hands of students and it does not require that academic staff be experts across all areas of technology use and development.

13. Rethink induction processes in relation to social technologies and formal learning

How will students be prepared to be more effective users of social technologies for formal learning? In the past, many HE institutions have offered induction courses where students are trained in IT use. As each new cohort entering higher education came with more sophisticated skills, universities found less need for these courses. However, if students are to use social technologies for formal learning there may be a need to reinstate such induction courses but in a new guise. This is true whatever approach is adopted: whether staff integrate new technologies and social networking methods into courses and programmes or create opportunities for students to use their own tools. Students will need to be able to select the most appropriate technology/software for the learning task they are required to undertake. In rethinking the format of induction, it will also be necessary to rethink whose task it would be to provide programmes that foster these skills. For example, it might require collaboration across learning technology support staff and academic teaching staff.

14. Devise new assessment practices more appropriate to 'learning as collaboration and participation'.

If HE institutions embrace the vision behind social technologies then this will require a shift with learning seen as more about collaboration and participation rather than about delivery by academic staff. This shift will also result in the use of a wider range of technology-supported learning methods (blogs, wikis, personal digital collections etc). Such changes raise specific issues for assessment. One issue concerns the balance of responsibility for assessment. A participation metaphor suggests that students share responsibility for assessment with their teachers: for example, evidence their learning against criteria that have been co-constructed with the teacher (e.g. as in portfolio processes) rather than receive a mark for delivering against predefined learning outcomes. Another issue is that, as assessment methods become more innovative (e.g. a wiki rather than an essay), marking and grading will become more problematic. This also highlights the need for more collaborative approaches to assessment.

Recommendations on socio-cultural issues

15. Build a campus culture rich in social networking opportunities

In order for social technologies and networking to be used effectively to support formal learning, they will not have to be used not only by students but also by staff. For example, it will not be possible to create a campus environment rich in social networking without a cultural shift by both staff and students. One way to cultivate this is to foster communities both within and across stakeholders in higher education. Communities of academics could explore new pedagogies and technologies, communities of technologists might support developments in the technological environment, communities of students will learn and share knowledge but there should also be opportunities for these communities to interact and build new cross-interest communities. A cultural change of this kind will require support across different levels of the organisation (see next section). A starting point would be greater use of social technologies within the day-to-day work of institutions.

Recommendations on organisational issues

16. Build staff capacity in the use of social and associated technologies

Academic staff as well as students will require skills in the use of social technologies for pedagogical purposes. They might also require support in moving their pedagogic approach to capitalise on social technologies, namely, from an acquisition approach to a participation approach to learning. Staff development initiatives however should not be provided for academic staff in isolation. It would benefit from the bringing together of teachers, those with pedagogical expertise in participative learning, IT and digital media specialists. One-on-one support models are probably inefficient and would not provide a sufficient return on investment.

17. Share responsibility for development across staff and students

Given that students might have more expertise or be more up-to-date than academic staff in technology use it might be worth employing such technology savvy students as a resource and support for academic staff wishing to design for learning using new technology. This is an approach adopted in some US institutions where senior students are paid to help develop courses and upload content.

18. Develop institutional strategies that provide reward and recognition for innovations in teaching

HE institutions might need to consider how they encourage and support innovative teachers who apply new social technologies in their courses. It has long been argued in HE that innovation should be rewarded but it might become much more important as institutions compete for students brought up using digital technologies for informal learning. Scholarly publications by academic staff who are engaged in exploring the impact of these technologies should be encouraged as this will help develop the evidence base required for continuous improvement.

Recommendations on technological issues

19. **Support the use of student tools within institutional settings**
    The ideal technological scenario for social technologies would be 'mix and match' where teachers and students could use e-tools provided by the institution and provided externally. This scenario is problematic given concerns about security, the potential for a digital divide in ownership and different levels of skills across staff and students. Yet despite these difficulties strategies are available to deal with some of the more obvious technological barriers. Simple technical requirements can be implemented, such as allowing students to plug in their own choice of storage device for their data, be it USB key, hard drive, iPod or mobile phone. Thoughtful consideration can also be given to the tools that students bring with them or those they wish to use, whilst balancing this against institutional resource capability. The majority of students own a range of (mobile) devices – laptops and mobile phones, so universities should consider whether provision of these tools on campus is necessary and to what extent. Universities might also consider providing spaces for students to lock up their mobile devices during the daytime if required. In the longer term systems should be developed that enable institutions to provide free-standing social spaces open to any student who wishes to set up an environment for group projects, to share learning resources etc. Codes of practice might be developed to encourage student self-monitoring and policing.

20. **More emphasis should be placed in HE on mobile devices and universal free access to high-speed networks from anywhere within the campus.**
    In some countries (e.g. Netherlands) universities provide wide-coverage (Wi-Fi) network access to their students and staff not only throughout the campus but also within the cities in which these universities are located.

6.3 Recommendations for further research

This study began to investigate the world of social and mobile technologies that have been taken up rapidly within societies but that are only just beginning to be explored and understood within the context of higher education. More **in-depth, longer-term studies with much larger groups of students and academics must be carried out** to explore the ways in which individuals learn using these technologies.

In this emergent area, there is wide range of questions and topics that could form a basis for future research agenda. Although it is unfeasible to elaborate on each of the potential questions, a number of key issues arising from this study that the UK Higher Education Academy may want to consider in future funding decisions are outlined below:

1. **Meta-analysis of research studies into students' experience of technology.** There have been quite a number of studies into students'

experiences of using technologies to support learning, which have been carried out in the UK and internationally. It might be useful to meta-analyse these studies to help us paint a more comprehensive picture of individuals' models of technology use and the broader implications for learning in general and for how learning is structured, managed and assessed within higher education in particular.

2. **Impact on learning outcomes.** Future research studies should focus not only on scoping learners' experiences, but on evaluating the types of impact that the use of technologies is making on learning outcomes and pedagogic effectiveness.
3. **Types of literacies that individuals develop through the use of social technologies outside formal educational setting.** Future studies might explore what new forms of literacies are developed when individuals use social technologies, which of these literacies are beneficial for what learning processes and how the appropriate literacies can be transferred to support learning in educational institutions. What scaffolds and tools would help learners to transfer these literacies across contexts?
4. **Longitudinal design experiments**. Future studies (especially if focusing on points 2 and 3 above) may be best addressed through longitudinal design experiments of large magnitude. Without good data of this sort it would be difficult to make significant progress (and hence move beyond mere rhetoric or theorising) in understanding the educational implications of the emergent technologies and the literacies and learning processes that they bring with them.
5. **Small-scale design experiments**. It might be useful to fund small-scale design experiments by lecturers in institutions of higher education, whereby technologies are implemented in a particular course, their impact on learning outcomes and other quantitative and qualitative impact measures is identified, and generic principles are derived from these implementations that could a) support future implementations in other contexts, b) contribute to the evidence base, c) contribute to the body of knowledge about pedagogy and curriculum design. It would be important to extend current studies in this area beyond mere evaluation-type activities.

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8 Appendices

Appendix 1 - Letter to the key contacts within the Schools

Dear <name>,

"Learning from digital natives: Integrating formal and informal learning" (LDN)

The Caledonian Academy at Glasgow Caledonian University is involved in a joint 'Higher Education Academy funded research project with Strathclyde University looking at students' use of e-tools in informal learning situations and how these can be integrated within formal learning. The project is co-directed by Professor Allison Littlejohn and Dr. Anoush Margaryan. You may have already heard about this project, but further details of our aims can be found on the project website at: http://www.academy.gcal.ac.uk/ldn/

We are just now organising contacts in both institutions, and you have been suggested as someone who may be interested in this study and who might be willing to participate. I hope you don't mind me contacting you by email in the first instance.

As part of this project we aim to carry out a range of surveys, focus groups and interviews with students and staff in the fields of Social Work and Engineering, across the two institutions, as detailed below:

1. 1 x paper based general survey on Level 3 students' use of electronic tools, both for their study and their home life. This will be in early 2007 and across both institutions, from the fields of Social Work and Engineering. This to be followed by
2. 6 x student interviews of around an hour each
3. 10 x staff interviews. We are very keen to interview staff in both institutions on their own experiences in this area, with particular focus on potential barriers and enablers. We would like to talk to both support and teaching staff.

All data would be treated confidentially, and we'd ask participants to sign a consent form before being interviewed.

We would very much appreciate your assistance in identifying and contacting potential classes of students and enthusiastic staff who would be willing to participate. We also hope that you would be willing yourself to be interviewed on your own experience and knowledge in this area.

Our liaison will be Kathy Trinder, one of the researchers on this project. She can be contacted at k.trinder@gcal.ac.uk

We look forward to hearing from you.

Best wishes,

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Appendix 2 - Schedule for staff semi-structured interviews

1. Briefly outline your role
2. What e-tools do you use with your students/are used in your division
    I. Why did you choose these, what influenced your decision?
3. What sort of e-tools would you like to use (that you don't currently use)?
    I. Why don't you use these currently?
4. Do your students go out on placement, how do they keep in touch?
5. Do you see your students using any other tools themselves such as phones, ipods, blogs, and youtube outside of class? Around the corridors, on or off campus?
    I. i.e. around campus, in the library etc, or that you know they use off campus?
    II. What are they using these for?
    III. Informal study groups?
6. Have you considered tapping into this use for their learning/your teaching?
    I. Do you see any of these as having educational value
7. What areas of teaching and learning do you think could benefit from use of tools that currently aren't used?
8. How did you learn to use these e-tools yourself?
    I. What influenced this?
    II. Did you get support? Learn yourself?
9. Are there any particular projects/initiatives (with e-tools or informal/formal learning?) you're involved in that may be of interest to us?

Appendix 3 – Student questionnaire

Higher Education Academy Funded Project
"Learning from Digital Natives: Integrating Formal and Informal Learning"

Student Questionnaire
The purpose of this questionnaire is to gather details regarding your use of technology, both on your formal course of study and your own personal use of technology. We would be very grateful if you could complete this questionnaire by ticking the boxes corresponding to your answer or entering an appropriate response when indicated. Your participation is entirely voluntary and although completing this questionnaire will not benefit you directly, it may impact on the future use of various technologies in Higher Education curricula. Responses are confidential.

We would also like to identify potential participants for future focus groups and interviews. There is a section at the end of this questionnaire where you can enter your email address so that we can contact you if you would be willing to take part. If you choose to participate, you will be paid for your time.

Section A – Your Personal Details

1. What is your gender?

Male ☐ Female ☐

2. How old are you? (Please enter your age in the box) ☐

3. What is your course of study?

BA Social Work ☐
BSc Engineering ☐

4. Do you currently have Internet access in your place of residence?

Yes ☐ No ☐

5. Do you access the Internet on campus, and if so where?

Library ☐ Labs ☐
Campus café ☐ Other ☐

6. Which of the following do you own and use regularly? (please tick as many as apply)

Mobile Phone	
Portable Media Player (e.g. iPod, mp3 player)	
Personal Computer (e.g. Mac, PC)	
Handheld Computer (e.g. PDA, Blackberry, Palmtop)	
Laptop computer	
Games Console (e.g. Xbox, Playstation, Nintendo)	

Portable Games Console (e.g. Gameboy, SonyPSP)	
Digital Camera	
Other(s) (please give details)	

Section B – Use of Technology on Your Course

This section concerns your use of technology on your modules for your chosen course of study.

7. In your current year of study (2006/2007), how many of your modules have content that you can access through the university's Virtual Learning Environment (VLE), e.g. Blackboard or WebCT?

All of my modules	
Most of my modules	
A few of my modules	
None of my modules	

8. Please indicate which electronic tools you use **in your course** and the extent to which you use them:

	daily	**weekly**	**monthly**	**never**
Course website (e.g. lecture notes, activities, PowerPoint slides, video clips)				
Online Discussion Groups				
Virtual/Real Time Chat Facility				
Video Conferencing				
Online Assessments (e.g. Multiple choice quizzes)				
MP3 player				
Digital Camera				
Handheld Computer				
Mobile Phone				
Podcasts				
Internet Websites				
Google/Google Scholar				
Wikipedia				
Simulations, games				
Message Boards				
Text Messaging				
MySpace				
Weblog or Blog				
YouTube				
Other(s) (please give details)				

Section C – Use of Technology For Your Own Learning

This section concerns your use of technology for the purpose of learning or communication *in relation to your course* (e.g. to talk to other students about coursework), but *NOT* tools provided by your university for the course

9. Please indicate which electronic tools **NOT** provided by the University you use to help you with your studies (e.g. this may be other software or your own tools and devices.)

	daily	weekly	monthly	never
MySpace				
Digital Camera				
Networked PCs/Macs				
Weblog or Blog				
Message Boards				
Mobile Phone				
Second Life				
Video/audio clips				
Course Websites				
Internet Websites				
Podcasts				
MP3 player				
Wikipedia				
Simulations, games				
Handheld Computer				
Text Messaging				
Chat				
YouTube				
Google/Google Scholar				
Other(s) (please give details)				

10. Would you like to use any of these tools/software formally as part of your course if not already being used?

Yes	No	Don't know

Section D – Other Use of Technology / Software

This section is about your use of technology *other than that detailed above*

11. Please indicate the extent to which you use the following electronic tools, software, websites etc., but **NOT** in relation to your course or study (i.e. for recreational use), and which particular ones you use.

	daily	weekly	monthly	never
Music (e.g. iTunes, MP3, etc)				
Photo upload and sharing (e.g. Flickr, Slide.com)				

Video upload and sharing (e.g.YouTube)				
Blogging (e.g. Blogger, Myspace)				
Social Networking (e.g. Myspace, Bebo)				
File sharing (e.g. Napster, BitTorrent)				
Discussion groups (e.g. Google Groups, Yahoo)				
Chat Rooms				
Wikis (e.g.Wikipedia)				
Virtual Worlds (e.g. Second Life)				
Internet gaming				
Others? (please give details)				

Section E – Further Participation In Our Study

Please tick the box below and enter your email address if you are interested in contributing further to our study by participating in a focus group and/or interview about your use of technology. Participants will be paid £5 for up to one hour of their time.

Yes, I am interested in taking part in a focus group discussion:

Please enter your email address (clearly, using block capitals) below:

Thank you for taking the time to complete this questionnaire.

Appendix 4 – Questionnaire summary

Sample size
N = 160

Institution
Total GCU = 80
Total Strathclyde = 80

Course of study
Total Engineering = 130
Total Social Work = 30
GCU Engineering (BSc Hons Engineering/Audio Technology) = 59
Strath Engineering (MEng Electrical and Mechanical/Aero-Mechanical) = 71
GCU Social Work (BA Hons) = 21
Strath Social Work (MA Hons) = 9

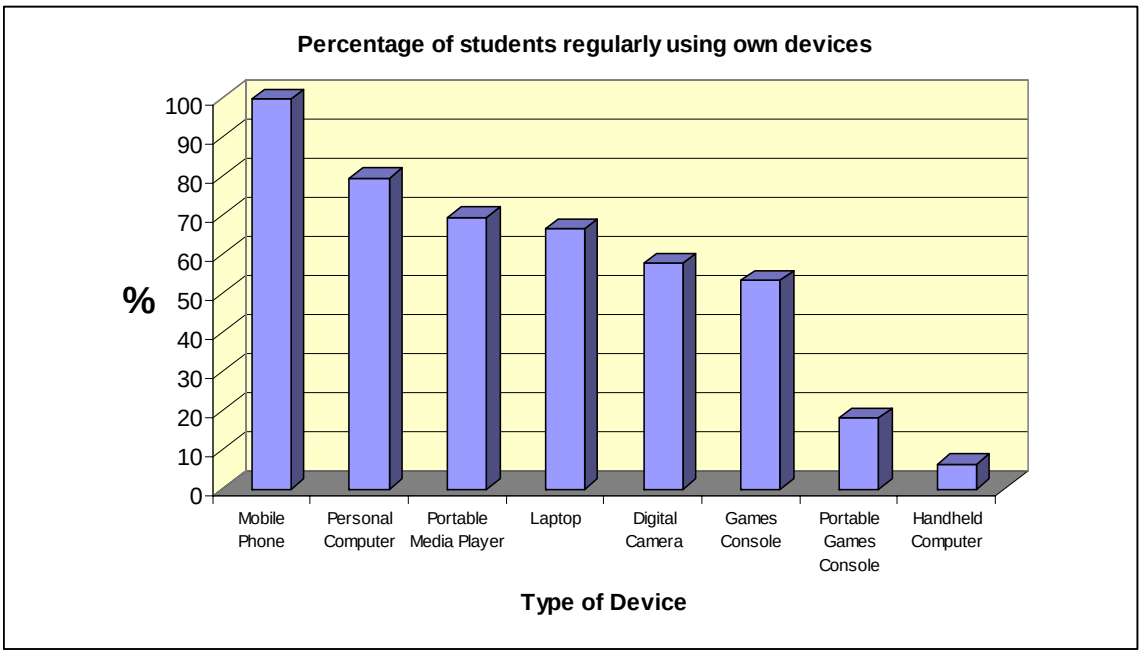
Gender
121 males, 39 females
Engineering (114 male, 16 female)
Social Work (7 male, 23 female)

Age
Range 19-50 yrs

Internet access:	**Yes**	**No**
Access at home:	145 (91%)	15 (9%)

Access on campus:	**Yes**	**No**
Library	139 (87%)	21 (13%)
Labs	132 (82%)	28 (18%)
Campus Cafe	38 (24%)	122 (76%)
Other	22 (14%)	138 (86%)

Figure 1: Section A: Hardware owned and used regularly



(Mobile Phone = 99%, PC = 79%, PMP = 69%, Laptop = 66%, Digital Camera = 58%, Console = 53%, PGC = 18%, Handheld = 6%)

Other hardware mentioned by respondents included:

- GPS systems, such as the popular TomTom;

- a variety of storage devices such as USB sticks and portable hard drives;
- video cameras, though it was not clear if respondents also used their phones for this function;
- musical instruments such as an electric guitar.

Formal use of technologies on courses

Table 1 – Section B: Students' Use of Technology on Their Course

	Daily	Weekly	Monthly	Never	Total
Course Pages	57% (81)	31% (48)	4% (7)	13% (21)	157
Discussion Groups	8% (12)	17% (27)	17% (28)	58% (93)	160
Virtual Chat	6% (10)	9% (15)	5% (8)	79% (127)	160
Video Conferencing	1% (2)	0% (0)	3% (5)	96% (152)	159
Assessments	2% (3)	4% (6)	40% (63)	54% (86)	158
MP3	21% (34)	8% (12)	3% (5)	68% (109)	160
Digital Camera	5% (7)	11% (18)	26% (42)	58% (93)	160
Handheld Computer	6% (10)	2% (3)	2% (3)	90% (144)	160
Mobile Phone	41% (66)	8% (13)	4% (6)	47% (75)	160
Podcasts	4% (6)	1% (1)	8% (13)	87% (140)	160
Websites	69% (110)	21% (34)	3% (5)	7% (11)	160
Google/Scholar	61% (97)	25% (41)	5% (8)	9% (14)	160
Wikipedia	25% (40)	32% (51)	20% (32)	23% (37)	160
Simulations/Games	8% (13)	8% (12)	16% (26)	68% (109)	160
Message Boards	15% (23)	18% (28)	17% (27)	50% (80)	159
Text Messaging	43% (68)	11% (18)	4% (7)	42% (67)	160
MySpace	9% (15)	6% (9)	5% (8)	80% (128)	160
Blog	6% (10)	2% (4)	6% (9)	86% (137)	160
YouTube	11% (17)	15% (24)	15% (25)	59% (94)	160
Other	Yes – 6 (MSN Messenger, Bebo, own website, Facebook, Hi5, Email, alluc.org)				

Table 2 – Section C: Students' use of technology for their own learning

	Daily	Weekly	Monthly	Never	Total
MySpace/Bebo	5% (8)	8% (13)	6% (9)	81% (126)	156
Digital Camera	3% (5)	9% (14)	25% (39)	63% (98)	156
PCs/Macs	35% (55)	19% (30)	5% (7)	41% (64)	156
Blogs	3% (5)	7% (11)	9% (14)	81% (126)	156
Message Boards	10% (15)	17% (26)	16% (25)	57% (89)	155
Mobile Phone	50% (78)	15% (23)	4% (7)	31% (48)	156
Second Life	3% (5)	1% (2)	3% (5)	93% (144)	156
Video/Audio Clips	13% (21)	22% (34)	18% (28)	47% (73)	156
Course Websites	39% (61)	30% (47)	11% (17)	20% (31)	156
Internet Websites	52% (81)	28% (44)	6% (9)	14% (22)	156
Podcasts	1% (2)	2% (3)	9% (14)	88% (137)	156
MP3 player	17% (27)	12% (18)	8% (13)	63% (98)	156
Wikipedia	25% (39)	28% (43)	20% (31)	27% (42)	155
Simulations/Games	7% (11)	7% (11)	10% (15)	76% (119)	156
Handheld Computer	4% (7)	4% (7)	4% (6)	87% (136)	156
Text Messaging	47% (73)	15% (24)	5% (8)	33% (51)	156
Instant Chat	26% (40)	12% (19)	6% (10)	56% (87)	156
YouTube	11% (17)	10% (15)	11% (18)	68% (106)	156
Google/ Scholar	41% (63)	28% (44)	7% (11)	24% (37)	155
Other	Yes - 1 WLAN (IEEE802.11g)				

Integration Question (posed after students completed Section C – Tools for Informal Learning)

Would you like to use any of these formally on your course? (N = 157)
Yes - 71 (45%)
No - 20 (13%)
Don't know - 66 (42%)

Table 3 - Section D: Other Use of Technology/Software

	Daily	Weekly	Monthly	Never	Total
Music (e.g. iTunes, MP3)	81% (129)	9% (15)	3% (5)	7% (10)	159
Photo upload/ sharing (e.g. Flickr,Slide.com)	17% (27)	31% (50)	34% (34)	30% (48)	159
Video upload/sharing (e.g. YouTube)	25% (40)	19% (31)	18% (28)	38% (60)	159
Blogging (e.g. Blogger, MySpace)	12% (19)	19% (30)	12% (19)	50% (91)	159
Social Networking (e.g. MySpace, Bebo)	33% (52)	23% (36)	11% (18)	33% (53)	159
File Sharing (e.g. Napster, BitTorrent)	26% (41)	23% (36)	13% (21)	38% (61)	159
Discussion Groups (e.g. Google/Yahoo)	8% (13)	11% (17)	13% (21)	68% (108)	159
Instant Chat/Chat Rooms	31% (49)	11% (17)	7% (11)	51% (82)	159

Wikis (e.g. Wikipedia)	21% (33)	32% (51)	24% (38)	23% (37)	159
Second Life	2% (3)	2% (4)	5% (8)	91% (144)	159
Internet Gaming	11% (17)	14% (22)	18% (28)	57% (92)	159
Other	Yes – 1 (Sony Play Station Portable)				

Figure 2: Section B Responses

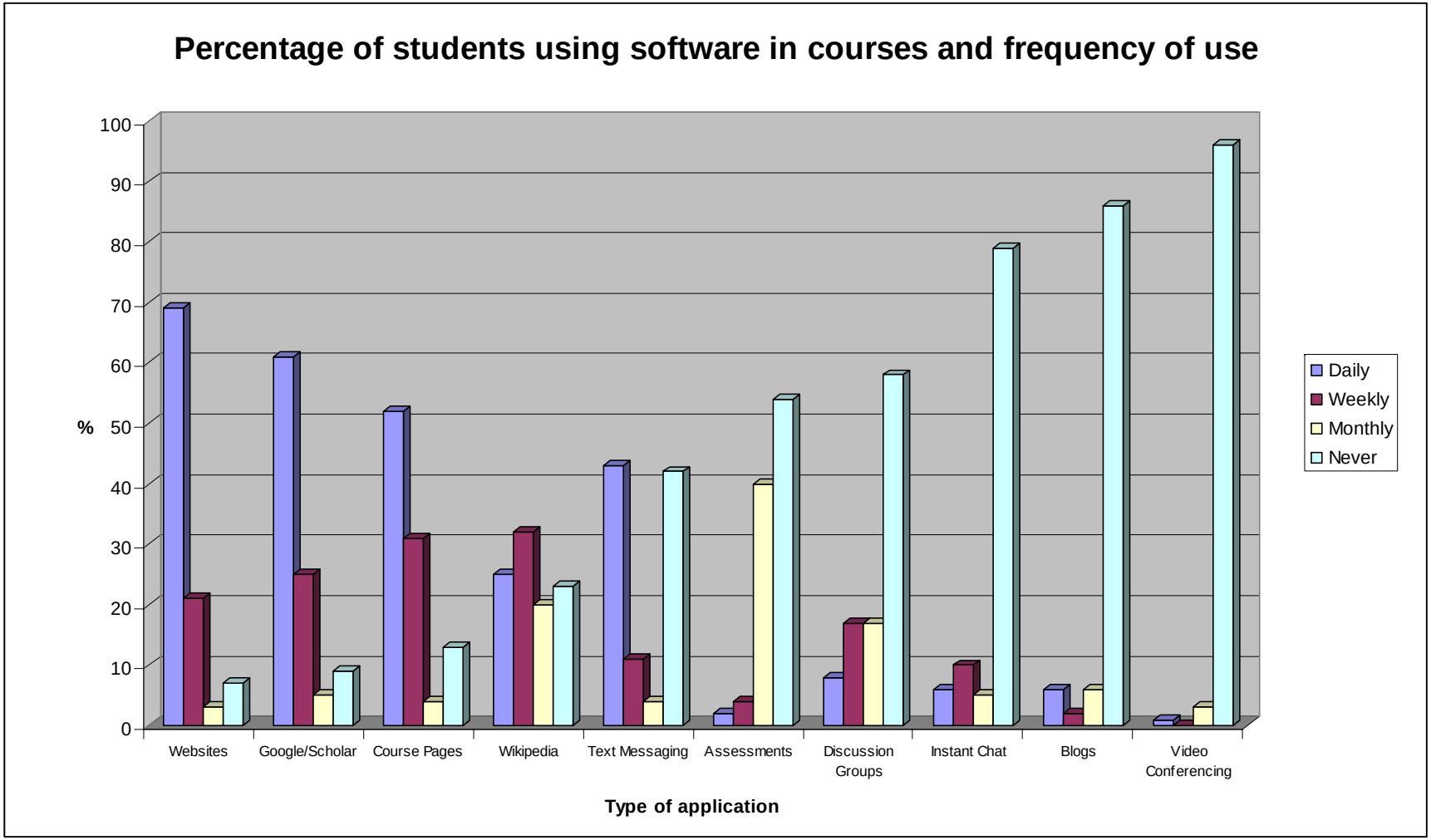


Figure 3: Section C Responses

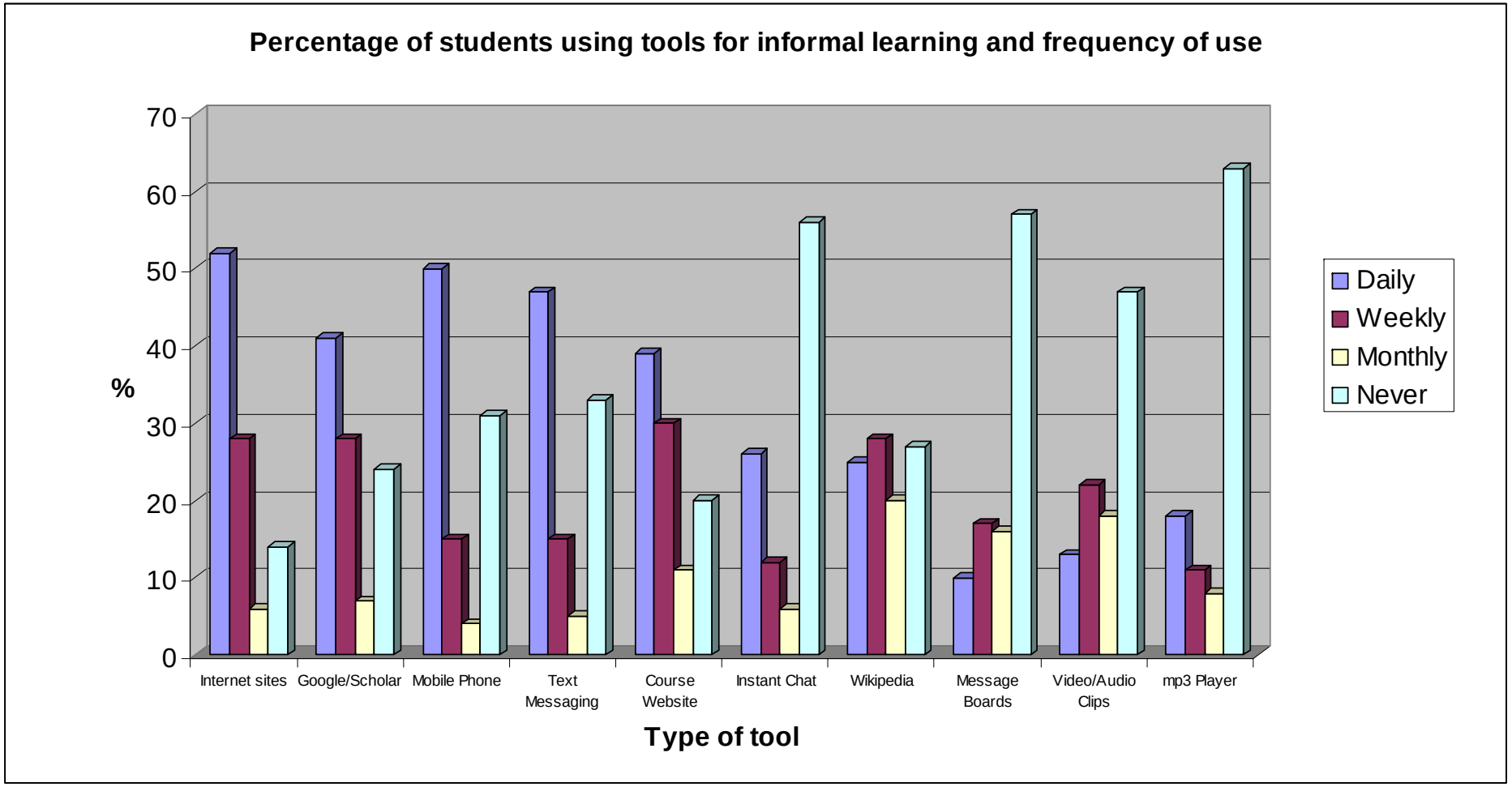


Figure 4: Section D Responses